

**Hurley**

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**A Concise  
Introduction to  
Logic**

**Fifth Edition**

# A CONCISE INTRODUCTION TO LOGIC

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**Fifth Edition**

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*"Oh, send him somewhere where they will teach him to think for himself!"  
Mrs. Shelley answered: "Teach him to think for himself? Oh, my God,  
teach him rather to think like other people!"*

*Matthew Arnold, Essays in Criticism*

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# PREFACE

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The most immediate benefit derived from the study of logic is the skill needed to construct sound arguments of one's own and to evaluate the arguments of others. In accomplishing this goal, logic instills a sensitivity for the formal component in language, a thorough command of which is indispensable to clear, effective, and meaningful communication. On a broader scale, by focusing attention on the requirement for reasons or evidence to support our views, logic provides a fundamental defense against the prejudiced and uncivilized attitudes that threaten the foundations of our democratic society. Finally, through its analysis of inconsistency as a fatal flaw in any theory or point of view, logic proves a useful device in disclosing ill-conceived policies in the political sphere and, ultimately, in distinguishing the rational from the irrational, the sane from the insane.

To realize the benefits offered by the study of logic, one must thoroughly understand the central concepts of the subject and be able to apply them in actual situations. To promote the achievement of these goals, this text presents the central concepts of logic clearly and simply. Examples are used extensively, key terms are introduced in boldface type and defined in the glossary/index, and major points are illustrated in graphic boxes. Furthermore, to ensure sufficient practice in applying the basic principles, the book includes over 2,000 exercises selected to illustrate the main points and guard against the most typical mistakes. In most cases, every third exercise is answered in the back of the book.

## New to the Fifth Edition

This fifth edition retains the basic format of its predecessors. The principal changes include the reorganization of Chapter 4 so that Venn diagrams are introduced early, thus allowing their use in the presentation of other concepts. Also, the material relating to the Boolean standpoint (the modern square of opposition, conversion, obversion, contraposition) is now presented prior to the material depending on the Aristotelian standpoint (the traditional square of opposition). This arrangement is thought to be more natural in that the simpler material is now introduced first, and it will more easily enable instructors who so wish to skip the later material. Also, Section 2.1 has been rewritten to recognize the fact that emotive language is often used to express value claims. Instruction is given on how to disengage such value claims from their emotive clothing and reexpress them in emotively neutral language.

Section 8.5 has been expanded to include the counterexample method for proving invalidity, Section 8.3 now takes an intuitive approach to the change of quantifier rules, dialogue exercises have been added to Chapter 3, a sufficiency proof of the five rules for syllogisms has been added to Section 5.3, Bayes's theorem is now included in Section 9.3, and a mnemonic is included in Section 4.2 to assist in remembering how the categorical propositions distribute their terms. To shorten the time involved in making the transition to this new edition, a complete list of changes by page number is given in the instructor's manual.

Other changes include the creation of a special supplement intended for writing-intensive logic courses, and a second supplement dealing with truth trees. These supplements will be supplied without charge to students of instructors who order them.

Robert Burch has updated his study guide, and I am confident that students will continue to find it useful as a supplementary source of exercises and a review for examinations. Also, Nelson Pole has extended and refined his computer software, titled *LogicCoach*, which is available free of charge to adopters of this book. *LogicCoach* provides an excellent opportunity for student practice in working the many exercises that appear throughout the textbook.

## Alternative Approaches to the Textbook

Depending on the instructor's preferences, this textbook can be approached in several ways. The following chart presents possible approaches for three different kinds of course.

In general, the material in each chapter is arranged so that certain later sections can be skipped without affecting subsequent chapters. For example, those wishing a brief treatment of natural deduction in both

**TYPE OF COURSE**

	<b>Traditional logic course</b>	<b>Informal logic course, critical reasoning course</b>	<b>Course emphasizing modern formal logic</b>
<b>Recommended material</b>	Chapter 1 Chapter 3 Chapter 4 Chapter 5 Chapter 6 Sections 7.1–7.4	Chapter 1 Chapter 2 Chapter 3 Chapter 4 Sections 5.1–5.3 Sections 5.5–5.6 Sections 6.1–6.4 Section 6.6 Section 9.1 Sections 9.4–9.5 Writing Supplement	Chapter 1 Sections 4.1–4.3 Section 4.6 Sections 6.1–6.5 Chapter 7 Chapter 8 Truth Tree Supplement
<b>Optional material</b>	Chapter 2 Sections 7.5–7.7 Chapter 9	Section 5.4 Section 5.7 Section 6.5 Sections 9.2–9.3	Chapter 3 Sections 4.4–4.5 Sections 5.1–5.2 Section 5.7 Section 6.6

propositional and predicate logic may want to skip the last three sections of Chapter 7 and the last four (or even five) sections of Chapter 8. Chapter 2 can be skipped altogether, although some may want to cover the first section of that chapter as an introduction to Chapter 3. Finally, the five sections of Chapter 9 depend only slightly on earlier chapters, so these sections can be treated in any order one chooses.

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For their reviews and suggestions leading to this fifth edition I want to thank Robert Burch, Texas A&M University; Ping-Tung Chang, University of Alaska; Jack Crumley, University of San Diego; Clinton Dunagan, St. Philips College; LeAnn Fowler, Slippery Rock University; Bernard D. Freyberg, Slippery Rock University; Joseph Georges, El Camino College; Ken Hanley, Brandon University; Ronald Hill, University of San Diego; R. I. G. Hughes, University of South Carolina, Columbia; Moya Kinchla, Bakersfield College; James Manns, University of Kentucky; David O'Connor, Seton Hall University; Linda Peterson, University of San Diego; Nelson Pole, Cleveland State University; T. R. Quigley, Oakland University; Philip Schneider, George Mason University; Thomas Warren, Solano Community College; Paul Weirich, University of

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# 1

## BASIC CONCEPTS

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### 1.1 ARGUMENTS, PREMISES, AND CONCLUSIONS

**Logic** may be defined as the science that evaluates arguments. All of us encounter arguments in our day-to-day experience. We read them in books and newspapers, hear them on television, and formulate them when communicating with friends and associates. The aim of logic is to develop a system of methods and principles that we may use as criteria for evaluating the arguments of others and as guides in constructing arguments of our own. Among the benefits to be expected from the study of logic is an increase in confidence that we are making sense when we criticize the arguments of others and when we advance arguments of our own.

An **argument**, as it occurs in logic, is a group of statements, one or more of which (the premises) are claimed to provide support for, or reasons to believe, one of the others (the conclusion). All arguments may be placed in one of two basic groups: those in which the premises really do support the conclusion and those in which they do not, even though they are claimed to. The former are said to be good arguments (at least to that extent), the latter bad arguments. The purpose of logic, as the science that evaluates arguments, is thus to develop methods and techniques that allow us to distinguish good arguments from bad.

As is apparent from the above definition, the term “argument” has a very specific meaning in logic. It does not mean, for example, a mere

verbal fight, as one might have with one's parent, spouse, or friend. Let us examine the features of this definition in greater detail. First of all, an argument is a group of statements. A **statement** is a sentence that is either true or false—in other words, typically a declarative sentence or a sentence component that could stand as a declarative sentence. The following sentences are statements:

Aluminum is attacked by hydrochloric acid.  
Broccoli is a good source of vitamin A.  
The *Lusitania* was sunk by the British navy.  
Napoleon prevailed at Waterloo.  
Rembrandt was a painter and Shelley was a poet.

The first two statements are true, the second two false. The last one expresses two statements, both of which are true. Truth and falsity are called the two possible **truth values** of a statement. Thus, the truth value of the first two statements is true, the truth value of the second two is false, and the truth value of the last statement, as well as that of its components, is true.

Unlike statements, many sentences cannot be said to be either true or false. Questions, proposals, suggestions, commands, and exclamations usually cannot, and so are not usually classified as statements. The following sentences are not statements:

What is the atomic weight of carbon? (question)  
Let's go to the park today. (proposal)  
We suggest that you travel by bus. (suggestion)  
Turn to the left at the next corner. (command)  
Right on! (exclamation)

The statements that make up an argument are divided into one or more premises and one and only one conclusion. The **premises** are the statements that set forth the reasons or evidence, and the **conclusion** is the statement that the evidence is claimed to support or imply. In other words, the conclusion is the statement that is claimed to follow from the premises. Here is an example of an argument:

All crimes are violations of the law.  
Theft is a crime.  
Therefore, theft is a violation of the law.

The first two statements are the premises; the third is the conclusion. (The claim that the premises support or imply the conclusion is indicated by the word "therefore.") In this argument the premises really do support the conclusion, and so the argument is a good one. But consider this argument:

Some crimes are misdemeanors.  
Murder is a crime.  
Therefore, murder is a misdemeanor.

In this argument the premises do not support the conclusion, even though they are claimed to, and so the argument is not a good one.

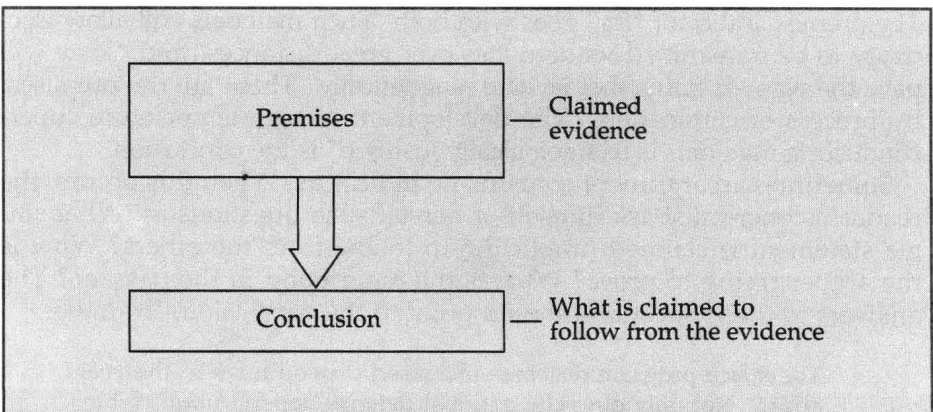
One of the most important tasks in the analysis of arguments is being able to distinguish premises from conclusion. If what is thought to be a conclusion is really a premise, and vice versa, the subsequent analysis cannot possibly be correct. Frequently, arguments contain certain indicator words that provide clues in identifying premises and conclusion. Some typical **conclusion indicators** are

therefore	hence	whence
wherefore	thus	so
accordingly	consequently	it follows that
we may conclude	we may infer	implies that
entails that	it must be that	as a result

Whenever a statement follows one of these indicators, it can usually be identified as the conclusion. By process of elimination the other statements in the argument are the premises. Example:

Corporate raiders leave their target corporation with a heavy debt burden and no increase in productive capacity. Consequently, corporate raiders are bad for the business community.

The conclusion of this argument is "Corporate raiders are bad for the business community," and the premise is "Corporate raiders leave their target corporation with a heavy debt burden and no increase in productive capacity."



If an argument does not contain a conclusion indicator, it may contain a premise indicator. Some typical **premise indicators** are

since	in that	seeing that
as indicated by	may be inferred from	for the reason that
because	as	inasmuch as
for	given that	owing to

Any statement following one of these indicators can usually be identified as a premise. Example:

Expectant mothers should never use recreational drugs, since the use of these drugs can jeopardize the development of the fetus.

The premise of this argument is "The use of these drugs can jeopardize the development of the fetus," and the conclusion is "Expectant mothers should never use recreational drugs."

One premise indicator not included in the above list is "for this reason." This indicator is special in that it comes immediately *after* the premise that it indicates. "For this reason" (except when followed by a colon) means for the reason (premise) that was just given. In other words, the premise is the statement that occurs immediately *before* "for this reason." One should be careful not to confuse "for this reason" with "for the reason that."

Sometimes a single indicator can be used to identify more than one premise. Consider the following argument:

The development of high-temperature superconducting materials is technologically justified, for such materials will allow electricity to be transmitted without loss over great distances, and they will pave the way for trains that levitate magnetically.

The premise indicator "for" goes with both "Such materials will allow electricity to be transmitted without loss over great distances" and "They will pave the way for trains that levitate magnetically." These are the premises. By process of elimination, "The development of high-temperature superconducting materials is technologically justified" is the conclusion.

Sometimes an argument contains no indicators. When this occurs, the reader/listener must ask himself or herself such questions as: What single statement is claimed (implicitly) to follow from the others? What is the arguer trying to prove? What is the main point in the passage? The answers to these questions should point to the conclusion. Example:

The space program deserves increased expenditures in the years ahead. Not only does the national defense depend upon it, but

the program will more than pay for itself in terms of technological spinoffs. Furthermore, at current funding levels the program cannot fulfill its anticipated potential.

The main point of this argument is that the space program deserves increased expenditures in the years ahead. All the other statements provide support for this statement. This example reflects the pattern of most (but not all) clear-cut arguments that lack indicator words: The conclusion is the first statement. When the argument is restructured according to logical principles, however, the conclusion is always listed *after* the premises:

- P<sub>1</sub>: The national defense is dependent upon the space program.
- P<sub>2</sub>: The space program will more than pay for itself in terms of technological spinoffs.
- P<sub>3</sub>: At current funding levels the space program cannot fulfill its anticipated potential.
- C: The space program deserves increased expenditures in the years ahead.

When restructuring arguments such as this, one should remain as close as possible to the original version, while at the same time attending to the requirement that premises and conclusion be complete sentences that are meaningful in the order in which they are listed.

Note that the first two premises are included within the scope of a single sentence in the original argument. For the purposes of this chapter, compound arrangements of statements in which the various components are all claimed to be true will be considered as separate statements.

Passages that contain arguments sometimes contain statements that are neither premises nor conclusion. Only statements that are actually intended to support the conclusion should be included in the list of premises. If a statement has nothing to do with the conclusion or, for example, simply makes a passing comment, it should not be included within the context of the argument. Example:

Socialized medicine is not recommended because it would result in a reduction in the overall quality of medical care available to the average citizen. In addition, it might very well bankrupt the federal treasury. This is the whole case against socialized medicine in a nutshell.

The conclusion of this argument is "Socialized medicine is not recommended," and the two statements following the word "because" are the premises. The last statement makes only a passing comment about the argument itself and is therefore neither a premise nor a conclusion.



Closely related to the concepts of argument and statement are those of inference and proposition. An **inference**, in the technical sense of the term, is the reasoning process expressed by an argument. As we will see in the next section, inferences may be expressed not only through arguments but through conditional statements as well. In the loose sense of the term, “inference” is used interchangeably with “argument.”

Analogously, a **proposition**, in the technical sense, is the meaning or information content of a statement. For the purposes of this book, however, “proposition” and “statement” are used interchangeably.

## Note on the History of Logic

The person who is generally credited as being the father of logic is the ancient Greek philosopher Aristotle (384–322 B.C.). Aristotle’s predecessors had been interested in the art of constructing persuasive arguments and in techniques for refuting the arguments of others, but it was Aristotle who first devised systematic criteria for analyzing and evaluating arguments. Aristotle’s logic is called **sylogistic logic** and includes much of what is treated in Chapters 4 and 5 of this text. The fundamental elements in this logic are terms, and arguments are evaluated as good or bad depending on how the terms are arranged in the argument. In addition to his development of sylogistic logic, Aristotle cataloged a number of informal fallacies, a topic treated in Chapter 3 of this text.

After Aristotle’s death, another Greek philosopher, Chrysippus (279–206 B.C.), one of the founders of the Stoic school, developed a logic in which the fundamental elements were whole propositions. Chrysippus treated every proposition as either true or false and developed rules for determining the truth or falsity of compound propositions from the truth or falsity of their components. In the course of doing so, he laid the foundation for the truth functional interpretation of the logical connectives presented in Chapter 6 of this text and introduced the notion of natural deduction, treated in Chapter 7.

For thirteen hundred years after the death of Chrysippus, relatively little creative work was done in logic. The physician Galen (A.D. 129–c. 199) developed the theory of the compound categorical syllogism, but for the most part philosophers confined themselves to writing commentaries on the works of Aristotle and Chrysippus. Boethius (c. 480–524) is a noteworthy example.

The first major logician of the Middle Ages was Peter Abelard (1079–1142). Abelard reconstructed and refined the logic of Aristotle and Chrysippus as communicated by Boethius, and he originated a theory of universals that traced the universal character of general terms to concepts in the mind rather than to “natures” existing outside the mind, as