THE ART OF LOGICAL REASONING

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PREFACE

My subject is how to articulate and evaluate arguments according to logical standards broadly conceived. As rigorous as any up-to-date introduction to formal logic, as practical as any of the fashionable treatments of informal logic, my approach is neither of these. It is a sophisticated introduction to applied logic, a rigorous approach to critical thinking.

This is a textbook, but not just a textbook. It is written for students, but written no less for a general audience: for speakers and writers, for editors and critics, for lawyers, teachers, policy-evaluators, and others who wish to improve their logical skills, or who simply enjoy argument, language, and intellectual challenge.

Writers of logic texts typically begin with a body of theory (first-order predicate logic, a taxonomy of fallacies), whence they extract principles and techniques whose mastery, they assure us, aids one in some important (if largely unspecified) modes of reasoning and criticism. Having found scant cause for such assurance, I took the opposite approach. Instead of beginning with a body of theory and extracting principles and techniques whose mastery might serve some hazy skill objective, I began with a skill objective—an unquestionably important one—then worked back to such theory-related principles and techniques as seemed useful in achieving that objective. Because studying this book involves practicing the skill objective itself, the notorious problem of educational transfer is largely overcome.

What is this objective? In rough terms, it is the ability to pick apart, reconstruct, and criticize pieces of reasoning in the careful, rigorous, sharply focused way philosophers typically do. This skill is by no means peculiar to philosophy; philosophers are just peculiarly explicit and self-conscious about it. It is best described, perhaps, as *the art of composing a closely reasoned critical or argumentative essay.*

After identifying this skill objective in a rough way, I analyzed it, more fully and precisely, as a series of steps. These are briefly summarized in § 7.1, summarized in greater detail in Appendix One, elaborated in Chapters 7 to 9, extended in Chapter 10, and given sustained illustration in Chapters 11 and 12. Working back to basics, I then identified some concepts and techniques that are essential to this objective and some that help one fulfill it. These are explained in Chapters 1 to 6.

Courses and textbooks devoted to formal or symbolic or mathematical logic have their place. Especially when presented in a theoretical rather than mechanical way, the subject is interesting on its own account, it helps one use and understand formal theories, and it is good background for studies in philosophy, artificial intelligence, structural linguistics, and other subjects. But it does not equip one with most of the tools one needs to analyze and evaluate real reasoning couched in ordinary language.

Standard treatments of so-called informal logic trade logical rigor for offhand applicability. Containing more informality than logic, they provide tools that are wanting in temper and sharpness. We expect well-educated people to construct and criticize pieces of reasoning with an uncommon degree of rigor, subtlety, and precision—just the qualities that are downgraded by many informal-logic texts.

Although I ignore symbolic logic, I dwell on *deductive validity*. I try to equip students with a firm grasp of the general concept and real skill at applying it—skill that outlives memory of algorithmic routines. The reason is not that evaluating an argument is mainly a matter of deciding whether a given conclusion is a valid consequence of given premises; rarely does argumentative discourse display premises and a conclusion related this way. The reason rather is that analyzing an argument is largely a matter of *reconstructing* it so that the conclusion is a valid consequence of the premises. This in turn is partly a matter of formulating validating tacit premises (I spell out the details in Chapter 7). Validity is less a trait to be found in argumentative discourse than a constraint on the way one reconstructs such discourse. There lies its importance.

In Part Two (Chapters 4 to 6) I explain and illustrate the use of Venn diagrams for ascertaining validity. Simple, natural, and pictorial, the Venn-diagram technique is easier to learn, harder to forget, more efficient to use, and more likely to be internalized than comparable symbolic methods. What is more, it gives a "yes" or "no" answer to questions of validity; it does not involve the translation of English into another, mathematical-looking language; it can be mastered without memorizing rules; it enables one, not only to ascertain validity, but to identify validating tacit premises; and it draws upon geometric skills to enhance less-developed logical skills. As they are standardly presented, of course, Venn diagrams apply only to a small class of arguments. But this is a limitation of standard presentations, not of the diagrams themselves. The Venn-diagram technique presented here fully accommodates singly quantified monadic predicate logic; it also handles singular terms, predicate modifiers, certain relational locutions (not all, of course), and non-truth-functional sentential connectives.

While I do not adopt the fallacy-label approach (or even use the word "fallacy"), I share many concerns with partisans of that approach. In effect (though usually not in quite these terms), I discuss non sequitur in Chapters 1 to 6, fallacies of ambiguity in Chapter 8, fallacies of false cause in Chapter 10, the fallacies of composition and division in §§ 8.3 and 12.3, inconsistency in §§ 3.4 and 9.3, question-begging also in § 9.3, and hasty generalization in §§ 9.4 and 10.3. I do not explicitly discuss the traditional formal fallacies, because I give a sustained treatment of deductive validity in Parts One and Two. Neither do I explicitly discuss certain traditional fallacies of relevance, because when arguments that commit these fallacies are reconstructed according to the method of

Chapter 7, their irrelevant appeals (to authority, to force, to the people, or whatever) are transformed into distinct, blatantly unacceptable premises.

I explain and illustrate my procedure for analyzing and criticizing arguments in Chapters 7 to 9. Chapters 10 extends the procedure to explanations and reverse-explanation arguments. Chapters 11 and 12 contain sustained applications of the procedure. Any of Chapters 10, 11 and 12 can be omitted from a course to satisfy a time constraint. Chapters 1 and 2 and § 3.4 are essential in understanding the rest of the book. The remainder of Chapter 3 and Chapters 4 to 6 are not strictly essential. I think they are important, naturally; I know they help students master the procedure of Chapters 7 to 9. But depending on your priorities and constraints, you might properly find a good deal of Chapters 3 to 6 to be dispensable. I hope you will be able at least to cover Chapter 4—the first of the three Venn-diagram chapters: even a week's study of Venn diagrams makes a great improvement in one's ability to ascertain validity and to identify validating tacit premises. But I must emphasize that instructors who do not share my enthusiasm for Venn diagrams can skip most if not all of the Venn-diagram material and read around the few diagrams used in Chapters 7 and 8.

All or part of this text is easily combined with all or part of a short text on symbolic logic, informal fallacies, rhetoric, statistical fallacies, probability, scientific method, or philosophic analysis. It also is easily combined with a text on some substantive subject, such as practical ethics, current social issues, or problems of philosophy. Even apart from my judgment of what is important, I saw no reason to take up topics ably covered elsewhere. Among textbook writers, too many owe too much to too few.

Each chapter contains a large number of illustrative examples and exercises. Solutions to exercises marked with a star—about half the total—are given in Appendix Four.

I have used successive incarnations of this book in a course that fulfills a general requirement at the University of Texas, which has a relatively noncompetitive admissions policy. A majority of the students who have taken the course have been freshmen and sophomores. Some were urged to take the course by other professors, some by fellow students who had taken it before. Many took it as preparation for the LSAT (Law Boards), having been told by other students who had taken both the course and the LSAT that the course helped. Some students took the course because they thought they were particularly logical, more because they thought they were particularly deficient in logic. Some students took it because they appreciated the fraud perpetrated by curricula that stress topical coverage rather than skill enhancement. Surprisingly many took it for logical self-defense against roommates, friends, and paramours who had taken it. Perhaps the largest single group comprised those who found the course the most convenient way (or the only convenient way) to fulfill the general requirement. A perfectly representative sample of American college students this is not. But it is a diverse group, whose average ability should not be much above or below that of introductory-logic students at any respectable college or university.

Using this book, it is possible to teach a course students find easy. I hope you will not do so. Although I did not write the book for an elite audience, I intended it to be intellectually challenging. Education is struggle: to improve one's competence at anything, one must strive to exceed it. It takes a hard stone to hone a good tool to a nice edge, and a lot of grinding if the tool was dull.

Not that studying this book is all a dull grind. A gratifying number of students have told me they enjoyed the examples and exercises. The intellectual challenge, combined with occasional whimsey and topicality, makes the work fun for some.

This book reflects my experience teaching the art of logical reasoning. I hope future editions will reflect yours. Please share with me your reactions, good and bad, and any suggestions you have for improvements.

My academic creditors are too numerous for a fair accounting. But I must mention Susan Gragg, who helped me teach this material for several years; Dennis Packard, from whose own approach to teaching logic I have borrowed liberally; and especially Preston Covey, with whom I jointly conceived my general approach. I shall not minimize their contributions by denying them any responsibility for remaining deficiencies. Marguerite Ponder flawlessly typed difficult manuscript on short notice, correcting errors of mine in the process. My greatest single debt is to Jane Cullen of Random House. She saw the oak in the acorn, often more clearly than I.

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PART THREE: EVALUATIONS

PART FOUR: APPLICATIONS

1

Arguments

1.1. SOMETHING YOU GIVE

Much of what we shall do, you and I—much of what you doubtless do already—is construct arguments, evaluate arguments, argue about them even.

In my sense, an argument is something you give rather than something you have. It is a piece of reasoning, not a dispute, although a disputant might use it. When you say something and defend it—when you offer reasons to support it—your words constitute an argument. *An argument is any piece of discourse that gives reasons (good or bad) to support some statement.*

Examples of arguments, good and bad:

Example 1 Socrates is a man, and all men are mortal, so Socrates is mortal.

Example 2 Communists admire Marx. So do some faculty members. Therefore, some faculty members are Communists.

Example 3 We had best allow gas prices to rise to meet demand, else there will be a shortage, with long lines at gas pumps and stranded motorists.

Example 4 Because standard IQ tests are culturally biased, they are discriminatory. That makes it unconstitutional to use them in public schools.

Example 5 Without itches, we wouldn't enjoy scratching. Consequently, evil sometimes is necessary for the existence of good.

Example 6 A thousand balls have been drawn from the urn. All are blue. It is reasonable to expect the next ball drawn from the urn to be blue.

Example 7 It evidently rained, because the streets are wet.

Example 8 If it is wrong to kill a one-month-old infant but not a six-month fetus, there has to be a difference between them—not just some difference or other, but a *morally relevant* difference: there has to be something true of the six-month fetus but not of the one-month-old infant that makes it permissible to kill the former. Surely, though, there is no significant developmental difference, somatic or psychological. True, the six-month fetus is dependent on its mother for its life. But so, normally, is the one-month-old infant—in a different way, of course, but to no less a degree. Apparently there is no morally relevant difference. Therefore, if it is not wrong to kill a six-month fetus, it is not wrong to kill a one-month-old infant. But the latter *is* wrong. Hence, so is the former.

Example 9 My walking on your lawn doesn't violate your right that I not do so unless you don't want me to walk there. My driving your car doesn't violate your right that I not drive it unless you don't want me to drive it. My doing something doesn't violate any right of yours unless you desire that the thing not be done. But a fetus has no desires, hence no desire not to be killed. So even if a fetus has a right not to be killed, killing it would not violate that right.

Example 10 If capital punishment deterred crime, it would be justified. It doesn't. So it isn't.

Example 11 Homosexual acts involving only consenting adults have no victims. So how can you call them crimes?

Example 12 THEOREM: If $x + y$ is odd, then x or y is even.
Proof: If x and y are both odd, then $x-1$ and $y-1$ are even, and thus, since a sum of even numbers must itself be even, $(x-1) + (y-1) + 2$ is even. But $(x-1) + (y-1) + 2 = x + y$. So if x and y are both odd, $x + y$ is even. Hence, if $x + y$ is odd, either x or y must be even, q. e. d.

1.2. THE GROSS ANATOMY OF ARGUMENTS

The statements constituting an argument, called the *steps* of the argument, come in three varieties:

(i) A *conclusion* This is the statement the argument is designed to support or defend.

Here are the conclusions of Examples 1–4:

Socrates is mortal.

Some faculty members are Communists.

We had best allow gas prices to rise to meet demand.

It is unconstitutional to use standard IQ tests in public schools.

of Examples 7 and 8:

It rained.

It is wrong to kill a six-month fetus.

and of Example 11:

Homosexual acts involving only consenting adults are not crimes.

Instead of slavishly copying the relevant sentence from each argument, I formulated each conclusion as a fully explicit declarative sentence devoid of extraneous matter. But *you* need not be so fussy at this stage. Asked for the conclusion of an argument, you may adhere as closely as you like, consistent with intelligibility, to the original text of the argument. The important thing is to distinguish the conclusion from the rest of the argument.

What are the conclusions of Examples 5, 6, 9, 10, and 12? (Do not proceed till you have answered this question!)

(ii) *Premises* In most arguments, at least one statement is affirmed without any defense.* An argumentative starting point, it is used to defend the conclusion but is not itself defended in the argument in question, although it could be the conclusion of another argument. Such

*The exceptions, for the record, are arguments whose conclusions are so-called *logical truths*, e.g.: "Either all swans are white or not all swans are white."

a statement is one of the *ultimate reasons* given by the argument to support its conclusion: it is one of the argument's *premises*.

Example 2 has two premises:

> Communists admire Marx.
>
> Some faculty members admire Marx.
>
> (*or*: So do some faculty members.)

Here are the premises of Example 6:

> A thousand balls have been drawn from the urn.
>
> All the balls drawn from the urn are blue.
>
> (*or*: All are blue.)

Asked for the premises of Example 1, you could say this argument has one premise, "Socrates is a man, and all men are mortal," or two, "Socrates is a man" and "All men are mortal." I prefer the second answer. Either is correct.

Example 10 has two premises. What are they? (Do not proceed till you have answered this question!)

Extracting premises from surrounding text can be tricky. Look at Example 3:

> We had best allow gas prices to rise to meet demand, else there will be a shortage, with long lines at gas pumps and stranded motorists.

The first clause, "We had best allow gas prices to rise to meet demand," is the conclusion, not a premise. But "there will be a shortage, with long lines . . ." is not a premise either. Why? Because the author of Example 3 is not saying that a shortage *will occur*. He evidently hopes his recommendation is followed and thinks no shortage will occur in that case. He is just saying that a shortage will occur *if* his recommendation is *not* followed. His premise, in other words, is the following:

> Either we allow gas prices to rise to meet demand, or else there will be a shortage, with long lines at gas pumps and stranded motorists.

The clause "else there will be a shortage . . ." is elliptical for this premise. That means the "else" clause is an incomplete sentence whose missing part, "either we allow gas prices to rise to meet demand," is understood from context.

Identifying the premises of the remaining examples raises special difficulties, which I discuss shortly.

An argument is no better, in a way, than its premises. Although impeccably reasoned, it will not enhance the credibility of its conclusion if its premises are implausible. Thanks to an implausible premise, this argument lends no support to its conclusion:

> Queen Elizabeth II is a vampiress. Therefore, she is not a strict vegetarian.

(iii) *Intermediate steps* Even when the premises of an argument would, if plausible, support the conclusion, this connection between premises and conclusion might not be obvious. To make it obvious, one adds further steps to the argument—not additional premises, but assertions designed to *bring out the connection* between premises and conclusion. These I call *intermediate steps*.

Like most arguments commonly encountered, Examples 1–3 and 5–7 contain no intermediate steps. Example 4 contains one:

> Standard IQ tests are discriminatory.

Because this step is offered as a reason for believing the conclusion, it must be a premise or an intermediate step. But because the premise, "Standard IQ tests are culturally biased," is offered as a reason for believing this step, this step is not offered as an *ultimate* reason for believing the conclusion. That is, it is not a premise. So it must be an intermediate step. Example 8 contains two intermediate steps:

> There is no morally relevant difference (between a one-month-old infant and a six-month fetus).
>
> If it is not wrong to kill a six-month fetus, it is not wrong to kill a one-month-old infant.

Do Examples 10 and 11 contain intermediate steps? (Do not proceed till you have answered this question!)

Sometimes it is hard to decide whether a step is a premise or an intermediate step. Take another look at Example 9:

> My walking on your lawn doesn't violate your right that I not do so unless you don't want me to walk there.
>
> My driving your car doesn't violate your right that I not drive it unless you don't want me to drive it.
>
> My doing something doesn't violate any right of yours unless you desire that the thing not be done.
>
> A fetus has no desires, hence no desire not to be killed.

So even if a fetus has a right not to be killed, killing it would not violate that right.

The third sentence states a general principle, of which the first two sentences give examples. If the examples are supposed merely to clarify the principle, then the third sentence is a premise and the first two are not steps of any sort—not really parts of the argument. But if the examples are supposed to support the principle—to enhance its credibility—then the first two sentences are premises and the third is an intermediate step.

In Example 12, distinguishing premises from intermediate steps is problematic for a reason I discuss in the next section.

1.3. MISSING PIECES

Sometimes an argument's *conclusion is unstated.* Suppose I say:

> I oppose the death penalty because it has not been shown to be an effective deterrent.

Then I have given an argument against the death penalty. Its conclusion is not: "I oppose the death penalty." Its conclusion, unstated, is something like: "The death penalty is unjust." What I am trying to convince my audience is not that I oppose the death penalty (they can take my word for that), but that the death penalty merits opposition.

Often an argument contains *unstated premises*—premises implicitly used in the argument but assumed to be so obvious to the likely audience that it would be gratuitous to mention them. Unstated premises often are called *assumptions.*

Consider this argument:

> Capital punishment must be unjust, because it has not been shown to be an effective deterrent.

The conclusion is:

> Capital punishment is unjust.

The single *stated* premise is:

> Capital punishment has not been shown to be an effective deterrent.

Something like the following seems to function as an *un*stated premise:

> A punishment is unjust if it has not been shown to be an effective deterrent.

To be sure, the author of the argument might insist that *this* really is not his tacit premise. He might say, for example, that what he tacitly assumed were these two statements:

> A *severe* punishment is unjust if it has not been shown to be an effective deterrent.
>
> Capital punishment is severe.

It is hard to tell with absolute certainty what an argument's tacit premises are.

Examples 1 and 2 do not seem to rest on any tacit premises. Here are Examples 3, 4, and 8, with tacit premises made explicit:

Example 3

> Either we allow gas prices to rise to meet demand, or else there will be a shortage, with long lines at gas pumps and stranded motorists. (express premise)
>
> Allowing gas prices to rise to meet demand is better than there being a shortage, with long lines at gas pumps and stranded motorists. (tacit premise)
>
> If doing something is better than not doing it, we had best do it. (tacit premise)
>
> We had best allow gas prices to rise to meet demand. (conclusion)

Example 4

> Standard IQ tests are culturally biased. (express premise)
>
> Whatever is culturally biased is discriminatory. (tacit premise)
>
> Standard IQ tests are discriminatory. (intermediate step)
>
> It is unconstitutional to use anything discriminatory in public schools. (tacit premise)
>
> It is unconstitutional to use standard IQ tests in public schools. (conclusion)

Example 8

> If it is wrong to kill a one-month-old infant but not a six-month fetus, there has to be a morally relevant difference between them (that makes it permissible to kill the latter). (express premise)
>
> There is no significant developmental difference, somatic or psychological, between a one-month-old infant and a six-month fetus. (express premise)

A one-month-old infant is no less dependent on its mother for its life than is a six-month fetus. (express premise)

Any morally relevant difference between a one-month-old infant and a six-month fetus (that makes it permissible to kill the latter) is either a significant developmental difference, somatic or psychological, or else a difference consisting in the infant being less dependent on its mother for its life than is the fetus. (tacit premise)

There is no morally relevant difference between a one-month-old infant and a six-month fetus (that makes it permissible to kill the latter). (intermediate step)

If it is not wrong to kill a six-month fetus, it is not wrong to kill a one-month-old infant. (intermediate step)

It *is* wrong to kill a one-month-old infant. (express premise)

It is wrong to kill a six-month fetus. (conclusion)

Sometimes it is not clear whether a step is a stated premise, or an intermediate step supported by a tacit premise. In Example 12, the step:

If x and y are both odd, then $x-1$ and $y-1$ are even

could be either a premise or an intermediate step justified by this tacit premise:

For any n, if n is odd, then $n-1$ is even.

Do Examples 5, 6, 7, 8, 10, and 11 have tacit premises? (Do not proceed till you have answered this question!)

An argument with tacit premises or a tacit conclusion is called an *enthymeme*. Most everyday arguments are enthymemes.

1.4. DEDUCTIVE ARGUMENTS

So-called *deductive* arguments constitute the most widely studied, best-understood class of arguments. Among the arguments we shall play with, deductive ones are of supreme importance. Mathematical proofs are deductive arguments. It is the business of the science of logic

(as opposed to the *art* of logic, which is our present concern) to theorize mathematically about correct and incorrect deductive arguments.

The author of any argument makes, or at least commits himself to accepting, three contentions:

(i) The premises are true.

(ii) The conclusion is true.

(iii) Truth of the premises would enhance the credibility of the conclusion.

What makes an argument *deductive* is that its author goes beyond (iii), contending:

> Supposing the premises to be true, it would be *impossible* for the conclusion not to be true as well. One who affirms the premises but denies the conclusion contradicts oneself.

All arguments purport to show that their premises, if true, would provide some support for their conclusions. A deductive argument purports to show more: that the evidentiary connection between premises and conclusion is the strongest it could possibly be. One who gives a deductive argument holds that truth of the premises would not only support but *necessitate* truth of the conclusion—that the premises could not possibly be true without the conclusion being true.

Another way to say that an argument is deductive is to say that it is an attempt to *deduce* its conclusion *from* its premises, or to show, to prove, to demonstrate that the conclusion *follows from* or is *logically implied by* or is *entailed by* or is a *logical consequence of* its premises.

Example 1 pretty clearly is a deductive argument. Because truth of the premises, "Socrates is a man" and "All men are mortal," would so obviously necessitate that of the conclusion, "Socrates is mortal," the author of this argument doubtless meant to maintain as much.

Let us suppose that Example 6 has no tacit premises—a reasonable enough supposition. Then this argument clearly is not deductive. Although unlikely, it is *possible* for all thousand balls drawn from the urn to be blue without the next one being blue. Truth of the stated premise would merely support, not necessitate, that of the conclusion. Because this is so obvious, the argument's author doubtless meant to maintain no more.

It would be wrong to characterize all deductive arguments as *conclusive* arguments, or even *purportedly* conclusive ones. An argument, deductive or not, is only as good as its premises. Insofar as there is doubt about the truth of any essential premise, the conclusion is left somewhat in doubt. And insofar as an argument leaves its conclusion in doubt, it does not conclusively support the conclusion. The author of a deductive argument holds that his conclusion could not possibly be false *if his premises be true.* That is not the same as holding that his conclusion could not possibly be false.

The author of Example 1 could conceivably have been a logical milk-toast, who meant merely that the premises enhanced the likelihood of the conclusion. And the author of Example 6 could conceivably have been a logical daredevil, who meant that truth of the stated premise would necessitate that of the conclusion. In the first case, Example 1 would not be a deductive argument after all. In the second, Example 6 would be a deductive argument. It would be a bad one, though, because the purported necessary connection between premise and conclusion obviously does not obtain. Rarely can one tell *with complete certainty* whether an argument is deductive. It depends on the author's contention regarding the premise-conclusion relationship, and rarely is that contention fully explicit.

Actually, putting it this way understates the problem of classification. We have been supposing that Example 6 has no tacit premises. Suppose we now allow it this tacit premise:

> If a thousand balls have been drawn from the urn and all are blue, then the next ball drawn from the urn will be blue.

Then we can reasonably construe Example 6 as a *pretty good* deductive argument. For truth of its two premises would not merely support but necessitate that of its conclusion. What is more, to assert or accept the original argument is to assert or accept, among other things and without further defense, that the conclusion is true if the premises are true. So it is perforce to assert or accept, without further defense, the new premise. Therefore, even if the new premise is false or otherwise objectionable, adding it to the premises cannot impair the argument: although not a premise, it already was an undefended part of the argument.

To be sure, Example 6 with the tacit premise is no better *as an argument* than Example 6 without the tacit premise. Adding that premise adds no support to the conclusion. It just enables us to treat the argument as deductive.

As this illustrates, *any argument can be construed as deductive without impairment*—though often without improvement. For this reason, although I expect you to understand the special contention that makes an argument deductive (truth of premises would necessitate truth of conclusion), I do not expect you to be able to sort garden-variety arguments into deductive and nondeductive display cases.

We shall study deductive arguments for the most part. Or rather, we shall construe the arguments we study as deductive for the most part, not much caring (because it does not much matter) whether their authors intended this construction.

1.5. INDUCTIVE ARGUMENTS

If an argument is not deductive, what is it? *Inductive,* perhaps. Custom ordains that every elementary discussion of *de*ductive arguments shall contrast these with so-called *in*ductive arguments. Custom is less instructive about the meaning of "inductive."

In a *wide sense,* an *inductive argument* is any *nondeductive* one—any argument whose premises purport merely to support, not to necessitate, its conclusion.

In a *narrow sense,* an inductive argument is an attempt to *generalize*: its conclusion generalizes the information contained in its premises.

Among inductive arguments in the narrow sense, the simplest reason from premises of this (or a similar) form:

> (i) Every A examined so far is B,

to the corresponding conclusion:

> (ii) Every A is B.

Example:

> All swans examined so far are white.
>
> Therefore, all swans are white.

Less simple inductive arguments, still in the narrow sense, can have weaker premises (affirming that most As examined so far, or a certain relatively large proportion of the As examined so far, are B) or additional premises concerning the distribution of the sample of As examined so far. They also can have weaker conclusions (affirming that most As are B) or probabilistic conclusions (affirming the probability that a randomly selected A will be a B).

Every inductive argument in the narrow sense obviously is inductive in the wide sense, too. Is any argument inductive in the wide sense but not in the narrow sense? Construed as nondeductive, the following two arguments are of course inductive in the wide sense:

> Some swans have been examined so far, and all are white. Therefore, the next swan to be examined is white.
>
> Boris is Russian. But relatively few Russians are Baptist. And Boris is not known to belong to any category containing relatively many Baptists. Therefore, Boris is not Baptist.

Yet these arguments are not inductive in the narrow sense: their conclusions do not generalize the information contained in their premises. To be sure, one might fairly contend that the first argument involves an implicit generalization of the information contained in the premise—that the premise supports the conclusion only because it supports the generalization: "All swans are white." But that cannot be said of the "Boris" example.

Even in the narrow sense, some inductive arguments are bad arguments, despite unimpeachable premises. Sometimes (i) is unquestionably true yet fails to provide *any* support for (ii); it might even support the falsity of (ii). This is brought out by the following example, which we owe to the distinguished American philosopher Nelson Goodman.

You are familiar, of course, with the adjectives "blue" and "green." Here is a new one: "grue." To call something *grue* is to say that it is either *green (all over) and examined so far or blue (all over) and not yet examined.* Every emerald examined so far is green, hence grue. In other words, this premise, which has the form of (i), is true:

Every emerald so-far examined is grue.

Probably every emerald not yet examined also is green, hence not blue, hence not grue. Therefore, the corresponding conclusion of the form (ii), namely:

Every emerald is grue,

almost certainly is false; at any rate, it is unsupported by the premise. If anything, the premise supports the *falsity* of the conclusion. Sometimes, then, a premise of the form (i) provides no support for the corresponding conclusion of the form (ii).

For deductive arguments, logicians have developed fairly clear and complete criteria of correctness, which I discuss in subsequent chapters. We lack comparable criteria of inductive correctness. Sometimes (i) supports (ii); sometimes it does not. Students of inductive reasoning have not agreed on any rule for distinguishing the good cases from the bad.

EXERCISES

Identify the stated premises and conclusions of the following three arguments:

* 1. All conservatives are Republicans. But no Democrat is Republican. So no Democrat is conservative.

* 2. No worker is rich. But some Democrats are workers. So some Democrats are not rich.

3. Someone is a politician. And someone is greedy. Thus, someone is a greedy politician.

4. List the premises and intermediate steps (if any) of Examples 5, 11, and 12, labeling each step "stated premise," "tacit premise," or "intermediate step."

5. Do you think Example 4 is *deductive?* Explain.

For each of the following arguments, identify the conclusion, the stated premises, and the tacit premises (if any). Remember: Often you have some latitude in formulating premises and conclusions, stated and tacit. Do not worry about formulations. Just make sure in each case that you have distinguished the conclusion from the other steps and that you have distinguished each premise from the other steps.

6. All Podunk students are smart. But some people are not smart. So some people are not Podunk students.

* 7. I'm opposed to deregulating natural-gas prices, because deregulating the price of any good imposes an unfair burden on the poor.

8. SLA members often sincerely desire to better mankind. But terrorists are never thus sincere. So no terrorists are SLA members.

* 9. Dracula must be a jet setter because he enjoys a great night life.

10. I think Snow White is entitled to maternity insurance. After all, she must be a polyandrist, living as she does with a bunch of dwarfs.

* 11. If we adopt the bill, we're in for trouble. But if we reject it, we're in for trouble as well. *We're in for trouble!*

12. If we decontrol natural-gas prices, we place an unfair burden on the poor. But if we continue to regulate the price of natural gas, we impose unjust costs on future generations. Therefore, either we place an unfair burden on the poor, or we impose unjust costs on future generations.

* 13. If personality traits were hereditary, he-men would have he-children.

14. Why outlaw pornography? We know now that it does no psychological harm. And surely naked bodies per se are not evil.

* 15. You think God can do *anything*? Can He make a rock so big He cannot lift it?

16. Compared with smoking cigarettes, failing to have an annual dental examination does trivial harm to one's health. Consequently, it's unlikely that a person who troubles to have an annual dental examination would ever smoke cigarettes.

* 17. We all regard ourselves as having free will, because we all deliberate about alternative courses of action.

* 18. Societies are subject to the same ethical standards as individuals. But individuals may not kill others except in self-defense. Specifically, individuals

may not kill others just for the sake of retribution or deterrence. So society may not use capital punishment.

19. Owing to the danger of executing innocent people, capital punishment ought to be abolished.

20. Because almost everyone executed is poor, capital punishment is discriminatory.

21. Look and listen for arguments in books, magazines, newspapers, television shows, lectures, discussions, barroom disputes, lovers' quarrels, etc. Write down four. Identify stated premises, tacit premises (if any), intermediate steps (if any), and conclusions.

2

Deductive Validity

2.1. KANGAROOS AND VALID ARGUMENTS

The only animals in this house are cats.

Every animal is suitable for a pet that loves to gaze at the moon.

When I detest an animal, I avoid it.

No animals are carnivorous unless they prowl at night.

No cats fail to kill mice.

No animals ever take to me except what are in this house.

Kangaroos are not suitable for pets.

None but *Carnivora* kill mice.

I detest animals that do not take to me.

Animals that prowl at night always love to gaze at the moon.

Conclusion: I always avoid a kangaroo.

What you have just seen is a deductive argument—a *deductively valid* one, as it happens. It is *deductive* because its *conclusion purportedly follows* from its premises: its author, Lewis Carroll, held that truth of the premises would not only support but necessitate truth of the conclusion—that the conclusion must be true if the premises be true. It is *deductively valid* because (roughly speaking) Lewis Carroll was right: the *conclusion does follow* from the premises; the conclusion must indeed be true if the premises be true.

Note the difference between calling an argument *deductive* and calling it deductively *valid*. In a deductive argument, the conclusion *purpor-*

tedly follows from the premises—whether or not it actually follows. In a deductively valid argument, the conclusion does follow from the premises—whether or not it purports to follow. In the case of a deductive argument, the author *holds*, rightly or wrongly, that truth of the premises would necessitate truth of the conclusion. In the case of a deductively valid argument, truth of the premises *would* necessitate truth of the conclusion, whether or not the author thinks so or says so.

Here are three more deductively valid arguments:

Whoever is reading is literate.	true
You are reading.	true
Therefore, you are literate.	true

Whoever is reading is dead.	false
You are reading.	true
Therefore, you are dead.	false

Whoever is dead is reading.	false
You are dead.	false
Therefore, you are reading.	true

Observe that a deductively valid argument can have one or more false premises. While some have false conclusions as well, others have true conclusions.

The first argument has true premises. Its conclusion also is true. I gave no example of a deductively valid argument with true premises and a false conclusion. There is none. Why? (Do not proceed till you have answered this question!)

What makes an argument deductively valid—*valid*, for short—is not true premises or a true conclusion or both, but a certain *connection* between premises and conclusion: roughly speaking, the conclusion has to be true if the premises be true—which is not to say it is or they are.

A *sound* argument is *both valid and has true premises*. Of the three examples above, only the first is sound. Besides true premises, a sound argument (as just defined) always has a true conclusion. Why? (Do not proceed till you have answered this question!)

Examples of *invalid* (hence unsound) arguments:

If you are reading, you are literate.	true
You are literate.	true
Therefore, you are reading.	true

Whoever is reading is dead.	false
You are dead.	false
Therefore, you are reading.	true

If you are taking an exam, you are literate.	true
You are literate.	true
Therefore, you are taking an exam.	false

Whoever is literate is taking an exam.	false
Either you are taking an exam, or you are not reading.	false
Therefore, if you are literate, you are not reading.	false

In the first of these four examples, the premises and conclusion are true. Yet the argument is not valid. Although the conclusion is true, this fact is not guaranteed by the true premises. The conclusion did not have to be true, even given the truth of the premises. It just happens to be true, independently of the premises. In an invalid argument, the premises may or may not be true, and in either case the conclusion may or may not be true.

The premises and conclusion of an *in*valid argument can possess any combination of truth and falsity. That an argument is invalid tells us nothing about the truth or falsity of premises or conclusion. The premises and conclusion of a *valid* argument can possess any combination of truth and falsity save one: true premises plus false conclusion. That an argument is valid tells us just that it does not have *both* true premises *and* a false conclusion—though it may have either.

Here are several common ways to say the same thing about a given argument:

It is valid (deductively valid, logically valid).

The conclusion follows (follows logically) from the premises.

The conclusion is a valid consequence (logical consequence) of the premises.

The premises logically imply (validly imply, entail) the conclusion.

The conclusion must be true if the premises be true.

Truth of the premises would not merely support but necessitate truth of the conclusion.

It is impossible for the premises to be true without the conclusion being true as well.

You deny this when you say:

> The conclusion is independent (logically independent) of the premises.

2.2. VALIDITY AND OTHER VIRTUES

Validity is just one virtue a deductive argument can have, invalidity just one defect. Deductive arguments can be good or bad in many ways. They can be or fail to be clear, concise, polite, interesting, correctly spelled, important, nonequivocal, reverent, persuasive, elegant, inoffensive, clever, patriotic, pleasant, grammatical, funny, fair, and so on and on.

Here are three particularly important virtues even a valid argument might lack:

(i) *Truth of premises* True premises plus validity make an argument sound. False premises make even a valid argument unsound.

Once you have shown that an argument has at least one false premise, you have decisively refuted it, even if it is valid and its conclusion is true. For anyone aware of what you have shown can no longer accept one of the ultimate reasons (premises) offered in defense of the conclusion. The conclusion might still be true, but not for the reasons given.

(ii) *Sufficient plausibility of premises* For an argument to provide any support for its conclusion, its premises must be plausible—plausible enough, anyway, to enhance the conclusion's credibility to some degree.

False premises often are not sufficiently plausible. But even true premises can fail to be sufficiently plausible. Of the following two arguments, each is valid, each has a true conclusion, and one (we do not know which) has only true premises, hence is sound:

> There have been living things on Mars.
>
> Anything on Mars is in the solar system.
>
> Therefore, there have been living things in the solar system.

> There have never been living things on Mars.
>
> Anything born on Mars is a living thing on Mars.
>
> Therefore, you were not born on Mars.

Yet each of these arguments has a first premise that is not plausible enough to support its conclusion. So a *sound* argument need not be a *good* argument: it can fail to provide any support whatever for its conclusion. Soundness is not the inclusive virtue it is sometimes touted to be.

A particularly glaring case of a premise that is not sufficiently plausible is a *question-begging* premise—one that is identical or close to the conclusion it is used to support. Example:

> Only a Communist would support busing.
>
> Therefore, any supporter of busing must be a Communist.

Just as a true premise can fail to be sufficiently plausible, so a sufficiently plausible premise can turn out to be false. You probably find these statements eminently plausible: "The author of this book never was a professional barber." "The author of this book never had a job playing the role of a ventriloquist's dummy." Both are false.

If your premises are plausible enough and your argument otherwise virtuous, you have argued well—you have given what we should normally consider a pretty good argument—even if one of your premises turns out to be false. It is reasonable to demand that people make the best use of the information available to them. It is not reasonable to demand omniscience.

Plausibility can vary with audience and time. One man's axiom (God exists) is another's absurdity. New truths are discovered (Germs cause disease), erstwhile truisms discarded (Noxious effluvia cause disease). Lesson: When giving or evaluating an argument, define and keep in mind the intended audience—and date of performance.

(iii) *Evidence of validity* The validity of a valid argument is not always evident. Although (roughly speaking) the conclusion must be true if the premises be true, this connection between premises and conclusion may not be obvious.

The two arguments about dead readers obviously are valid. Although valid, Lewis Carroll's argument about kangaroo-avoidance is not *obviously* valid. To make its validity evident, we must add suitable *intermediate steps*. If we succeed, we shall have *deduced* or *derived* the conclusion *from* the premises, and our words will constitute a *deduction* or *derivation* or *proof* of the conclusion from the premises. Example:

Premises

1. The only animals in this house are cats.
2. Every animal is suitable for a pet that loves to gaze at the moon.
3. When I detest an animal, I avoid it.
4. No animals are carnivorous unless they prowl at night.
5. No cats fail to kill mice.

Premises

6. No animals ever take to me except what are in this house.
7. Kangaroos are not suitable for pets.
8. None but *Carnivora* kill mice.
9. I detest animals that do not take to me.
10. Animals that prowl at night always love to gaze at the moon.

Intermediate steps

11.	Kangaroos do not love to gaze at the moon.	from 2 and 7
12.	Kangaroos do not prowl at night.	from 10 and 11
13.	Kangaroos are not carnivorous.	from 4 and 12
14.	Kangaroos do not kill mice.	from 8 and 13
15.	Kangaroos are not cats.	from 5 and 14
16.	Kangaroos are not animals in this house.	from 1 and 15
17.	Kangaroos never take to me.	from 6 and 16
18.	I detest kangaroos.	from 9 and 17

Conclusion

19.	I always avoid a kangaroo.	from 3 and 18

Such a derivation normally would be set out more colloquially, like this:

> Kangaroos are not suitable for pets (premise). But every animal is suitable for a pet that loves to gaze at the moon (premise). Therefore, kangaroos do not love to gaze at the moon (intermediate step), and thus, since animals that prowl at night always love to gaze at the moon (prem.), kangaroos do not prowl at night (i.s.). But no animals are carnivorous unless they prowl at night (prem.). Consequently, kangaroos are not carnivorous (i.s.), and hence, since none but *Carnivora* kill mice (prem.), kangaroos do not kill mice (i.s.), so that kangaroos are not cats (i.s.), inasmuch as no cats fail to kill mice (prem.). But the only animals in this house are cats (prem.), hence not kangaroos (i.s.), and no animals ever take to me except what are in this house (prem.). Therefore, kangaroos do not take to me (i.s.). As a result, I detest kangaroos (i.s.), since I detest animals that do not take to me (prem.). But when I detest an animal, I avoid it (prem.). Hence, I always avoid a kangaroo (conclusion).

Or consider the second argument about life on Mars. In case it is not completely obvious that the conclusion follows from the premises, we can make it obvious by adding an intermediate step:

> There have never been living things on Mars. (premise)
>
> But anything born on Mars is a living thing on Mars. (premise)
>
> So nothing was born on Mars. (intermediate step)
>
> In particular, then, you were not born on Mars. (conclusion)

The proofs you constructed in high-school geometry were attempted derivations of theorems from axioms. Each was a valid argument whose premises were the axioms of Euclidean geometry, whose conclusion was the theorem proved, and whose intermediate steps were the various steps you concocted to prove the theorem. Considerable time and ingenuity sometimes were required. There is no practicable, foolproof, generally applicable recipe for the construction of a correct derivation. Sometimes the deductive genius of a great mathematician is needed. Sometimes that is not enough.

2.3. A MATTER OF FORM

Roughly speaking, a deductively valid argument is one whose conclusion must be true if its premises be true. But only roughly speaking. It is time for some refinement.

What makes an argument valid is its *form*, its *shape*, its *structure*. Take:

> Every alien is a potential spy.
>
> François Abdul Benito Wahrhaftig is an alien.
>
> Therefore, François Abdul Benito Wahrhaftig is a potential spy.

It is valid. It has this form:

> Every A is a S.
>
> w is a A.
>
> ∴ w is a S.

In any argument of this form, if the premises are true, so is the conclusion. The form guarantees that the conclusion is true if the premises are. Some arguments of this form have false premises. But those with true premises have true conclusions as well. *That* is what makes the "spy" argument valid.

A (deductively) *valid argument* is one with this virtue:

EVERY ARGUMENT OF THE SAME FORM WITH TRUE PREMISES ALSO HAS A TRUE CONCLUSION

that is:

NO ARGUMENT OF THE SAME FORM HAS BOTH TRUE PREMISES AND A FALSE CONCLUSION.

A *valid argument-form* is an argument-form of which each argument with true premises has a true conclusion—an argument-form of which no argument has both true premises and a false conclusion. So a valid argument-form is the form of some valid argument, and a valid argument is one whose form is valid.

An *invalid argument* is one that is not valid, hence one for which some argument of the same form has both true premises and a false conclusion. Example:

Every spy is an alien.

François Abdul Benito Wahrhaftig is an alien.

Therefore, François Abdul Benito Wahrhaftig is a spy.

This argument has the form:

Every S is a A.

w is a A.

∴ w is a S.

It is invalid because some arguments of this form have true premises along with false conclusions. Example:

Every fraction is a number.	true
3 is a number.	true
Therefore, 3 is a fraction.	false

An argument automatically is invalid if it has true premises and a false conclusion. Some invalid arguments are not like this. They have false premises, or true premises plus true conclusions. They cannot be proved invalid by the simple route of pointing to true premises and a false conclusion. To prove them invalid on the basis of my definition, one must produce *another* argument of the *same form* with true premises and a false conclusion.

Sometimes an argument has true premises and a false conclusion, hence is invalid, yet its invalidity also must be established indirectly, because truth of the premises or falsity of the conclusion is not obvious and not easily established. Example: the second "spy" argument just above. In such a case, one must cite another argument of the same form with true premises and a false conclusion, but one whose premises *obviously* are true and whose conclusion *obviously* is false.

An *invalid argument-form* is an argument-form of which at least one argument has true premises along with a false conclusion. So an invalid argument-form is the form of some invalid argument.

An argument of a given form sometimes is called an *example* of that form. If its premises are true and its conclusion false, thereby establishing its own invalidity and that of the given form, then it is a *counter-example* to that form. (You will learn a different use of the term "counter-example" in Chapter 9.)

Although a valid argument-form can have only valid instances (examples), there is a sense in which an invalid argument-form can have valid as well as invalid instances. Consider:

It is not snowing.

It is raining or cloudy.

Therefore, it is cloudy.

It is invalid. It has this form:

not-A.

B or C.

∴ C.

Some arguments of this form have true premises along with false conclusions. (Find one!) Yet there is a sense in which other arguments of this form are quite valid, witness:

It is not raining.

It is raining or cloudy.

Therefore, it is cloudy.

This valid argument has the invalid form lately cited, but only in the sense that it has the *more specific, valid* form:

not-A.

A or C.

∴ C.

Do you see why the second form is a more specific version of the first? Look at it this way: Arguments of the first form come in two varieties: those in which the A clause and B clause are the same, and those in which the A clause and B clause are different. The arguments of the former variety are precisely those of the second, more specific form. So every argument of the second form also is of the first, less specific form, but not vice versa.

Many invalid argument-forms become valid when made more specific. For example, the argument-form:

A.

∴ B.

is invalid. (Prove this with a counter-example!) But the following, more specific form is valid:

B and C.

∴ C.

Lesson: Although one argument can have various forms, some more specific than others, THE form of an argument—that form which alone can bestow invalidity on the argument—is the *most specific* form it has.

2.4. ARGUMENTS AND ARGUMENT-FORMS: EXAMPLES AND COUNTER-EXAMPLES

Example 1

All huskies are dogs.
Every dog is a mammal.
So all huskies are mammals.

All H are D.
Every D is a M.
∴ All H are M.

VALID.

Example 2

No Republican is a Democrat.
Some Republican is a cucumber.
Therefore, some cucumber is not a Democrat.

No R is a D.
Some R is a C.
∴ Some C is not a D.

VALID. Remember: Validity is just one virtue of arguments. A valid argument need not be a good argument. A bad argument can nevertheless be valid.

Example 3

All huskies are mammals.
Every husky is a dog.
So all dogs are mammals.

All Hs are Ms.
Every H is a D.
∴ All Ds are Ms.

INVALID. Counter-example:

All huskies are dogs.	true
Every husky is a mammal.	true
∴ All mammals are dogs.	false

An invalid argument can nevertheless have true premises and a true conclusion. Note that a counter-example can sometimes be couched in the terms of the very argument whose invalidity it demonstrates. That is useful to keep in mind when looking for counter-examples.

Example 4

No conservative is a liberal.
But some Republicans are liberals.
So some Republicans are not conservatives.

No C is a L.
Some Rs are Ls.
∴ Some Rs are not Cs.

VALID.

Example 5

No liberal is a Republican.
But some Republicans are conservatives.
So some liberals are not conservatives.

No L is a R.
Some Rs are Cs.
∴ Some Ls are not Cs.

INVALID. Counter-example:

No positive number is a negative number.
Some negative numbers are numbers.
∴ Some positive numbers are not numbers.

This counter-example illustrates two important points:

First, an example of an argument-form, hence a counter-example to an argument-form, can contain a multiword phrase ("positive number") where the form contains a single letter ("L"). In constructing a counter-example to an argument-form, one replaces each place-holder letter with an English expression. That expression need not be a single word.

Second, elementary arithmetic is a good source of counter-examples. The premises of a good counter-example are *obviously* true and the conclusion *obviously* false. Because elementary arithmetic is familiar to everyone, simple arithmetic statements tend to be obviously true if true, obviously false if false.

Example 6 Some Presidents have been wealthy.
John Kennedy was a President.
Therefore, John Kennedy was wealthy.

Some Ps have been W.
k was a P.
∴ k was W.

INVALID. Counter-example:

Some Presidents have been wealthy.
Abraham Lincoln was a President.
∴ Abraham Lincoln was wealthy.

Anticipating a convention introduced in Chapter 4, I am using lower-case letters ("k") as place holders for proper names ("John Kennedy") and other expressions labeling single objects ("the world's ugliest logician"). But you may use any letters you like for now.

Example 7 All Presidents have been wealthy.
Abraham Lincoln was a President.
So Abraham Lincoln was wealthy.

All Ps have been W.
l was a P.
∴ l was W.

VALID.

Example 8 If Professor Q. E. Demonstratum succeeds in proving the theorem before class begins, he will not kill himself.

But he does kill himself.

So he does not succeed in proving the theorem before class begins.

If S, not-K.
K.
∴ not-S.

VALID.

In Examples 1–6, the significant structure consists in the way words form clauses, so place-holder letters stand for words. In Example 8, the significant structure consists in the way clauses form complete sentences, so place-holder letters stand for clauses.

Notice how I displayed the logical form of Example 8. Having represented the clause "he will kill himself" as "K," I then represented the clause "he will *not* kill himself" simply by prefixing "not" to "K," although the original clause does not begin with "not." Such simplifications are permissible, even desirable, when exact fidelity would be pointlessly cumbersome.

Example 9 The La Tour is preferable to the Château Margaux, which in turn is preferable to the Haut Brion.

Thus, the La Tour is preferable to the Haut Brion.

t is P to m.
m is P to b.
∴ t is P to b.

INVALID. Counter-example:

1 is next to 2.
2 is next to 3.
∴ 1 is next to 3.

If you thought Example 9 was valid, perhaps you were tacitly assuming the additional premise:

> If one thing is preferable to a second and the second is preferable to a third, then the first is preferable to the third.

The best counter-examples—those that most clearly demonstrate invalidity—often seem silly and contrived. That is no objection to them. When one constructs a counter-example, it is good strategy to use statements whose truth or falsity is so childishly obvious as to make the example seem silly.

A counter-example proves invalidity. But failure to find a counter-example does not prove validity: it does not prove there is none to be found. How to decide, in general, whether an argument is valid?

For some important classes of arguments, there are easily mastered methods of ascertaining validity. One such method is given in Part Two. For now, I leave you to your logical intuitions and your imagination. Faced with an argument whose validity you wish to ascertain, read it carefully, display its form, make an intuitive judgment of validity, and seek a counter-example to its form if validity is not evident. If the argument seems valid and you have found no counter-example, there is a good chance it is indeed valid—though it still may not be. If it seems *in*valid but you have found no counter-example, keep looking until you find one or feel satisfied there is none to be found. In seeking a counter-example, start with statements that are simple, trivial, even silly—ones whose truth (in the case of premises) or falsity (in the case of conclusions) is absurdly obvious.

In a genuine counter-example, it is obvious that the premises are true and the conclusion false. In a *near* counter-example, it obviously is *possible*, although not obviously the case, that the premises are true and the conclusion false. If you cannot find a genuine counter-example, seek a near counter-example. Here is a near counter-example to the form of Example 6:

Some men have been fat.
Ignatz was a man.
∴ Ignatz was fat.

Although it is not obvious that the premises are *in fact* both true and the conclusion false, it obviously is *possible* (depending on who Ignatz is) for the premises to be true and the conclusion false.

EXERCISES

For each of the following arguments, display its *form* and say whether it is *valid*. If it is *not valid*, prove this by giving a *counter-example* to its form—a genuine counter-example if you can, a near counter-example if that is the best you can do.

* 1. Socrates is a man.
All men are mortal.
So Socrates is mortal.

* 2. Communists admire Marx.
Some faculty members admire Marx.
Therefore, some faculty members are Communists.

* 3. Whoever is reading is literate.
You are reading.
Therefore, you are literate.

* 4. Whoever is reading is literate.
You are literate.
Therefore, you are reading.

5. All conservatives are Republicans.
But no Democrat is conservative.
Thus, no Democrat is a Republican.

6. All conservatives are rich.
Every Republican is rich.
So all Republicans are conservatives.

* 7. No worker is rich.
Some Democrats are workers.
So some Democrats are not rich.

* 8. No worker is rich.
Some Republicans are not rich.
So some Republicans are not workers.

9. Some Communists are atheists.
Therefore, some atheists are Communists.

10. All Communists are atheists.
Therefore, all atheists are Communists.

* 11. If Senator McGraft is honest, I'm a monkey's uncle.
Senator McGraft is honest.
So I'm a monkey's uncle.

12. No one can die who is made of dead men.
Frankenstein is made of dead men.
Consequently, Frankenstein cannot die.

13. Someone is a politician.
Someone is greedy.
Thus, someone is a greedy politician.

* 14. Whoever is prudent shuns hyenas.
No banker is imprudent.
So no banker fails to shun hyenas. (Lewis Carroll)

* 15. Some pillows are soft.
No pokers are soft.
Therefore, some pokers are not pillows. (Lewis Carroll)

16. Taxes are theft.
Licensing fees are theft.
Thus, licensing fees are taxes.

17. No capitalist belongs to a union.
Some professors are capitalists.
So some professors do not belong to unions.

3
Logical Form

3.1. FORM AND MATTER

There are many ways to impute form, shape, or structure to a bicycle, to a university, to a cantaloupe, or to a deductive argument. Every argument has a specific syntactic structure; it consists of a specific string of syllables; it is spelled a specific way. That form, shape, or structure which determines whether an argument is *valid* is called its *logical form.*

In depicting an argument's logical form, we delete certain expressions, replacing them with place-holder letters, but leave in certain others. Take:

Bertha is a wolf.

Every wolf is a mammal.

So Bertha is a mammal.

Its logical form is:

b is a W.

Every W is a M.

∴ b is a M.

I depicted it by deleting these expressions, treating them as nonstructural—as part of the *content* or *matter* of the argument:

Bertha wolf mammal.

I left these expressions, treating them as part of the argument's *form*, or *structure:*

is a *every*

Because the latter constitute the logical form of the argument, they are called *logical expressions.* The others—those deleted—are *nonlogical expressions.*

How, in general, do we decide which expressions are logical and which nonlogical? Why, from a logical point of view, do we regard expressions like "every" as bones of an argument and "wolf" as flesh?

Consider:

Jacob is a descendant of Isaac.

Isaac is a descendant of Abraham.

Therefore, Jacob is a descendant of Abraham.

Were "descendant" a logical expression, the argument would be valid, since it would then have the form:

a is a descendant of b.

b is a descendant of c.

∴ a is a descendant of c.

and every argument of this form with true premises has a true conclusion. But classifying "descendant" as flesh rather than bone makes the argument *in*valid, because it imputes to it the form:

a is a D of b.

b is a D of c.

∴ a is a D of c.

and *some* arguments of this form have true premises along with false conclusions, witness:

Jacob is a son of Isaac.

Isaac is a son of Abraham.

Therefore, Jacob is a son of Abraham.

As a matter of fact, logicians do *not* regard "descendant" as a logical expression. So they do not regard the "descendant" argument as valid.

But why? What makes "every" and "is a" logical expressions but "descendant" not a logical expression?

Maybe this: Genuine logical expressions occur in virtually all sciences and all general fields of discourse, regardless of subject matter. Nonlogical expressions do not. *Logical* expressions are *subject-independent*. *Non*logical expressions are *subject-specific*.

This criterion justifies the accepted view that the following are logical expressions:

and	or	not
every	some	is

while these are nonlogical:

descendant	Bertha	wolf
mammal	kangaroo	animals I detest

But the subject-independence criterion does not always yield a clear classification. For example, it is not completely clear whether these expressions pass the test of subject-independence:

because	possible	true	in order to
everywhere	more——than	while	

Subject-independence may be a *correct* criterion for distinguishing logical from nonlogical expressions. But it is an *imprecise* one: it admits of borderline cases.

Logicians often single out certain logical expressions for separate study, ignoring others—or rather, treating all others on a par with nonlogical expressions. In so-called propositional logic, for example, one studies separately the logic of "and," "or," "not," "if——then," and cognate expressions. That is, one develops a theory of validity that treats these expressions alone as logical. While studying this branch of logic, one deliberately—but temporarily—acts as though such logical expressions as "every" and "some" were nonlogical. Logicians have even investigated the "logic" of expressions not customarily regarded as logical, treating them as though they were logical. Examples:

——prefers . . . to - - -
It is possible that——
——asserts that . . . ——believes that . . .
It will happen in the future that ——.

One might take the view that nothing is a logical expression intrinsically, absolutely, or of itself, but only *relative to* a particular logical investigation or branch of logic—one that *treats it as* a logical

expression—and that any expression can, in principle, be a logical expression relative to some logical investigation or branch of logic. Our tendency to regard just the subject-independent expressions as really logical would then be explained by the fact that it is especially useful to study the logic of expressions that are especially prevalent.

By counting "descendant" as a logical expression, we make our little "descendant" argument valid, but at the cost of an enlarged logic—a criterion of validity complicated by the inclusion of "descendant," along with "and," "not," "every," and the like, among the logical expressions. By counting "descendant" as nonlogical, we save on logic at the cost of validity: our criterion of validity is then simpler, but our "descendant" argument no longer is valid. We can restore validity with no increase in logic by adding this premise, or construing it as an unstated premise of the original "descendant" argument:

> Whenever one thing is a descendant of another and the second is a descendant of a third, the first is a descendant of the third. (In short, descendants of descendants are descendants.)

In general, by counting an expression as logical, we save on premises and preserve the validity of some appealing arguments, but at the cost of added logic (of a more complicated criterion of validity); by counting it as nonlogical, we save on logic at the cost of added premises or the invalidity of some appealing arguments.

Strictly speaking, when depicting the logical form of an argument, it is not enough to delete the nonlogical expressions, marking their positions with letters. We must also specify, implicitly or explicitly, the *category* of expressions meant to fill each position. Here is a valid argument and its logical form:

Bertha kissed Ignatz.

Therefore, Bertha kissed something.

b K i.

∴ b K something.

But the following *in*valid argument seems to share this form:

Bertha kissed nothing.

Therefore, Bertha kissed something.

The trouble is that the "i" position is meant to be filled only by a proper name ("Ignatz") or other expression used to label a single object ("the tallest boy in the class"). But "nothing" is not of this sort. There is no such thing as nothing, let alone a single such thing. So "nothing" is not among the expressions meant to fill the "i" position. Therefore, the second argument does not really have the same form as the first.

Confused by all this? So am I. How exactly to distinguish logical from nonlogical expressions and categories is an unresolved issue in the philosophy of logic.

3.2. HOW TO DEVELOP GOOD FORM

So much for theory. Here are four rules of thumb to help you depict the logical forms of arguments:

1. When distinguishing logical from nonlogical expressions, follow these guidelines:

> By and large, *logical* expressions are those that seem intuitively to constitute the overall *form* or *shape* or *structure* of arguments; *nonlogical* expressions seem intuitively to constitute the *content* or *matter* of arguments.
>
> *Logical* expressions are *subject-independent*. Unlike nonlogical expressions, they do not express the specific topic or content or subject matter of arguments.
>
> Be *generous* to an argument's author: treat borderline cases as logical expressions if that is needed to make the argument valid.
>
> *Nonlogical* expressions include words, phrases, and clauses that stand for specific things ("Ignatz," "the tallest boy in the class"), for specific types or kinds of things ("dog," "beer," "assassinated archdukes"), for specific properties or traits or features of things ("canine," "heliotrope," "artfully naïve"), for specific sorts of action or event ("rains," "chews Bazooka"), for specific relations among things ("chews," "lies between"), and for specific putative facts ("she left him," "the moon is one-quarter the size of the earth").
>
> Although most verbs are nonlogical, "to be" is logical.
>
> Although most adjectives are nonlogical, certain adjectives of *quantity*, notably "all," "every," "some," and "most," are logical.
>
> Although most adverbs are nonlogical, "not" is logical, as are all expressions of *negation*—"it is not the case that," "un" (as in "ungrammatical"), "fail" (as in "he failed to come"), and so on.

2. Because *the* form of an argument is the *most specific* form it has, do not convict an argument of invalidity until you have uncovered *all* of its relevant structure. Even if it has an invalid form, the argument also could have a more specific, valid form. In a sense, this *valid* argument:

> Bertha is a wolf.
>
> Every wolf is a mammal.
>
> Therefore, Bertha is a mammal.

has the *in*valid form:

> A.
>
> B.
>
> ∴ C.

What makes it valid is that it also has the more specific, valid form:

> b is a W.
>
> Every W is a M.
>
> ∴ b is a M.

3. Once you have imputed a valid form to an argument, you may stop. There is no need to seek more structure. An argument with a valid form automatically is valid, even if that form is not THE form of the argument—not the most specific form it has. Reason: If an argument-form is valid, so is any more specific form. Example:

> If all humans are mortal, then Socrates is mortal.
>
> All humans are mortal.
>
> Therefore, Socrates is mortal.

This has the valid form:

> If P, then Q.
>
> P.
>
> ∴ Q.

That is enough to establish the argument's validity. It does not matter that the argument also has the more specific (no less valid) form:

> If all F are G, then a is G.
>
> All F are G.
>
> ∴ a is G.

4. When depicting the forms of arguments, feel free to *ignore features that play no logical role in the argument.* Besides making the work easier, this often enhances clarity and uncovers important structural similarities.

How to tell whether a structural feature plays a role in the argument? Sometimes it is intuitively obvious that a structural feature is merely grammatical or stylistic, not logical. And sometimes an expression's significant structural components do not occur elsewhere in the argument, in which case the expression's internal structure is not related to the rest of the argument and may be ignored.

Here are two valid arguments:

> Unless something is an animal, it is not a wart hog.
>
> Therefore, whatever kisses a wart hog kisses an animal.

> Unless something has legs, it does not dance.
>
> Therefore, whatever is a nose of a dancer is a nose of something that has legs.

It is perfectly proper to depict their respective forms as follows:

> Unless something is an F, it is not a G.
>
> ∴ Whatever Hs a G, Hs an F.

> Unless something F, it does not G.
>
> ∴ Whatever is an H of a G-er is an H of something that F.

But one can also simultaneously depict the form of both arguments this way:

> Unless something F, it not-G.
>
> ∴ Whatever Hs G, Hs F.

Because this form represents just those features common to the first two forms, it is simpler than they are. It is pretty obvious, I think, that those features represented in either of the first two forms but not in the third are merely grammatical and stylistic—not relevant to questions of validity.

Or consider this argument:

> There will be a run on the Pound if the Government lose their majority.
>
> There is indeed a run on the Pound.
>
> Therefore, the Government will lose their majority.

I should depict its form as follows:

> P if Q.
>
> P.
>
> ∴ Q.

This form obviously is invalid. (Stop and find a counter-example to it!) Yet one need not seek more structure. One need not depict the internal structure of the clauses "there will be a run on the Pound" and "the Government lose their majority." Such additional structure plays no role in the argument. For the clause "there will be a run on the Pound" shares no significant structural component with any other clause in the argument, so its internal structure is unrelated to the rest of the argument. Similarly for "the Government lose their majority."

3.3. MORE ARGUMENTS, ARGUMENT-FORMS, AND COUNTER-EXAMPLES

Example 1 Only Communists are atheists. But some atheists are congressmen. Hence, some congressmen are Communists.

> Only Cs are As.
>
> Some As are Ms.
>
> ∴ Some Ms are Cs.

VALID.

Example 2 None but atheists are Communists. But Madalyn is an atheist. Hence, Madalyn must be a Communist.

> None but As are Cs.
>
> m is an A.
>
> ∴ m is a C.

INVALID. Counter-example:

> None but human beings are U.S. senators.
>
> The Ayatollah Khomeini is a human being.
>
> ∴ The Ayatollah Khomeini is a U.S. senator.

Example 3 Whoever wears a heavy fur coat must be warm. Thus, whoever is not warm cannot be wearing a heavy fur coat.

Whoever C W.

∴ Whoever not-W not-C.

VALID. Because no significant structural component of "wears a heavy fur coat" occurs elsewhere in the argument, the internal structure of this phrase is not related to the rest of the argument, so it may be ignored.

Example 4 Those who drink heavily do not drive safely. But Tom drinks heavily. So Tom does not drive safely.

Those who H not-S.

t Hs.

∴ t not-S.

VALID. Because this form is valid as is, there is no need to make it more specific by displaying the internal structure of "drinks heavily" and "drive safely."

Example 5 Heavy drinkers do not drive safely. But Mormons do not drink at all. Consequently, Mormons drive safely.

H K-ers don't V S-ly.

Ms don't K at all.

∴ Ms V S-ly.

INVALID. Counter-example:

Heavy eaters don't eat moderately.

Rocks don't eat at all.

∴ Rocks eat moderately.

It was not necessary to display the internal structure of the phrase "drives safely." It *was* necessary to display the internal structure of "heavy drinkers," though, because one of its structural components, "drink," occurs by itself in the second premise. When showing an argument to be invalid, it is safer to display too much structure than too little.

Example 6 Every philosopher in Pittsburgh is a Fanatical Jogger or a Violent Vegetarian. But Preston is neither a Fanatical Jogger nor a Violent Vegetarian. Yet Preston is in Pittsburgh. Hence, Preston is not a philosopher.

Every S A is a P or a V.

n is neither a P nor a V.

n is A.

∴ n is not an S.

VALID.

Example 7 If Bertha is the culprit, Ignatz is not. In fact, Bertha is not the culprit. It follows that Ignatz must be the culprit.

If b is the C, i is not (the C).

b is not the C.

∴ i is the C.

INVALID. Counter-example:

If 3 is the number 4, 3 + 2 is not (the number 4).

3 is not the number 4.

∴ 3 + 2 is the number 4.

Example 8 All socialists are for Medicare. But some liberals are for Medicare. Hence, some liberals are socialists.

All Ss are M.

Some Ls are M.

∴ Some Ls are Ss.

INVALID. Counter-example:

All bananas are fruit.

Some strawberries are fruit.

∴ Some strawberries are bananas.

3.4. LOGICAL TRUTH AND CONSISTENCY

Validity is a formal property of arguments. But it is the business of logic to study certain kindred formal properties of statements and sets of statements as well. Two such properties are worth calling to your attention:

(i) *Logical truth* A statement is *logically true* if, and only if, *every statement of the same logical form is true.* In other words, a logical truth is a statement for which no statement of the same logical form is false.

Compare:

Every dog is a cat.

Every dog is an animal.

Every dog is a dog.

Because it is false, the first statement automatically fails to be logically true. Although true, the second statement is not *logically* true. For it has the form:

Every A is a B,

and *some* statements of this form, for example:

Every number is a rock,

are false. But the third statement is logically true. It has the form:

Every A is a A,

and *every* statement of this form is true: no false statement has this form.

Three more examples of logical truths and their forms:

If it is raining, it is raining.

If P, P.

Either it is raining or not.

Either P or not-(P).

Either someone is non-Albanian, or else everyone is Albanian or Liechtensteinian.

Either someone is non-A, or else everyone is A or B.

Logical truth and validity are different concepts. One applies to statements; the other, to arguments. One is a species of truth; the other is not: a valid argument can consist partly or wholly of falsehoods, so long as no argument of the same form consists of true premises plus a false conclusion. Despite their differences, logical truth and validity are both defined in terms of truth and logical form. And they are further connected this way:

Corresponding to every argument is the statement "If ______ then . . .," in which the "if" part is filled by the premises of the argument and the "then" part by the conclusion. An argument is valid if, and only if, its corresponding "If–then" statement is logically true. Examples:

ARGUMENT	CORRESPONDING "IF–THEN" STATEMENT
Every alien is a potential spy. But François Abdul Benito Wahrhaftig is an alien. Therefore, François Abdul Benito Wahrhaftig is a potential spy. (valid)	If every alien is a potential spy and François Abdul Benito Wahrhaftig is an alien, then François Abdul Benito Wahrhaftig is a potential spy. (logically true)
Every spy is an alien. But François Abdul Benito Wahrhaftig is an alien. Therefore, François Abdul Benito Wahrhaftig is a spy. (invalid)	If every spy is an alien and François Abdul Benito Wahrhaftig is an alien, then François Abdul Benito Wahrhaftig is a spy. (not logically true)

Note, by the way, that the "If–then" statement corresponding to an argument is not itself an argument. When you give an argument, you affirm, in effect, that the premises and conclusion are true. When you make the corresponding "If–then" statement, you do not thereby affirm that the "If" part (corresponding to the premises) or the "then" part (corresponding to the conclusion) is true. All you affirm is that the "then" part is true *if* the "If" part is true.

(ii) *Consistency* A *consistent* statement is one for which *some statement of the same logical form is true.* So truth is a species of consistency: every true statement is consistent, though not vice versa.

Compare:

Every adult man was born with a heart.

Every man is feathered.

Some men are not men.

Because the first statement is true, it is perforce consistent. Although false, the second statement still is consistent, because it has the logical form:

Every A is B,

and some statements of this form are true. (Find one!) But the third statement is not even consistent. Besides being false, it has the logical form:

Some As are not As,

and every statement of this form is false; no true statement has this form.

Statements that are *not* consistent are called *inconsistent.* The clearest cases are statements of this form:

A and not-A.

Such statements are called *explicit contradictions.* Often the label "contradiction," or "contradictory statement," is applied to inconsistent statements generally.

The negation of a logical truth is inconsistent; that of an inconsistent statement, logically true. Thus, "Every philosophy professor is or is not smart" is logically true, while its negation, "It is not the case that every philosophy professor is or is not smart," is inconsistent; and "Some philosophy professor is *and* is not smart" is inconsistent, while its negation, "It is not the case that some philosophy professor is and is not smart," is logically true.

The concepts of consistency and inconsistency apply to *sets* of statements as well as single statements. Each of these statements is consistent:

Ignatz kissed Bertha.

Ignatz did not kiss Bertha.

But they are *jointly in*consistent—inconsistent with each other. They constitute an inconsistent set. They have the forms:

A

Not-A,

and no two statements of these forms are *both* true.

The following statements, too, are each consistent but jointly inconsistent:

It is raining.

It is not both raining and snowing.

If it is not snowing, I'll be home by five.

Either I won't be home by five, or it is not raining.

They constitute an inconsistent set: no four statements of the same forms as these are all true. If that is not obvious, I can make it so by deducing an explicit contradiction from the four statements:

> Assume they are all true. Then it is not both raining and snowing. But it is raining. Hence, it is not snowing. But then, by virtue of the third statement, I'll be home by five, and thus, by virtue of the fourth statement, it is not raining. So it is both raining and not raining.

Because the explicit contradiction, "It is both raining and not raining," follows from the four statements above, if any four statements of the forms:

A.

Not both A and B.

If not-B, C.

Either not-C, or not-A.

were all true, so would be the corresponding statement of the form:

A and not-A.

But no statement of the latter form is true. Hence, no four statements of the forms just displayed are all true.

In general, if an explicit contradiction follows from a set of statements, those statements must be jointly inconsistent. So one way to show that a set of statements is inconsistent is to deduce from it an explicit contradiction.

People are said to be inconsistent when they hold positions that are singly or jointly inconsistent. And we call someone's words or thoughts inconsistent when his utterances or beliefs constitute an inconsistent set.

Logical truth and consistency are related to validity in a way you may find surprising and disturbing: An argument with *inconsistent premises* or a *logically true conclusion* is perforce *valid,* however unrelated its premises be to its conclusion. Reason: No argument of the same form can have both true premises and a false conclusion: there are no counter-examples to its form. (Think about it!) Examples:

This book is easy to read. E

This book is not easy to read. Not-E } (inconsistent)

Therefore, Queen Elizabeth II is a vampiress. Q

It is raining champagne. R

Therefore, this book is easy to read, or this book is not easy to read. E or not-E (logically true)

Because no argument of the former form can have true premises, while none of the latter form can have a false conclusion, there is no counterexample to either form, which is to say both arguments are valid.

You will not get too upset by this if you recall that validity is just one virtue of arguments. A perfectly valid argument can be very bad in other ways; a very bad argument can still be perfectly valid. Major evils often entail minor goods: accidents encourage safety, war engenders heroism, ignorance occasions inquiry, and inconsistent premises ensure validity.

3.5. BEYOND LOGICAL FORM (optional)

Validity, logical truth, consistency, and inconsistency are *formal* properties: whether an argument is valid depends solely on its logical form; similarly for the logical truth of statements and the consistency and inconsistency of statements and sets of statements.

Validity, logical truth, and inconsistency are the strictly formal versions of certain more inclusive, nonformal properties. The latter are worth calling to your attention if only to avoid confusion with their narrower, strictly formal kin.

Some truths are *necessarily* true: they could not possibly be false. (Those truths that are not necessarily true are called *contingent* truths.)

Logical truths are necessarily true. Besides being true, they could not possibly be false. But the logical truths do not exhaust the necessary truths. Some necessarily true statements are not logically true.

Here are four truths:

(1) All women are under twenty feet tall.

(2) There is no greatest integer.

(3) Every bachelor is male.

(4) Every bachelor is a bachelor.

Although true, (1) is *not necessarily* true. It is possible (even if extremely

unlikely) that there is a woman twenty feet tall or more. (2)–(4) are necessarily true. But only (4) is logically true. It has the form:

Every A is an A,

and every statement of this form is true. (2) and (3) have the respective forms:

There is no A-est B,

Every A is B,

and *some* statements of these forms are false. (Find one each! Do not proceed till you have done so!) So necessary truths are not always logically true.

Besides logical truths—statements true by virtue of their logical forms alone—the necessary truths include *mathematical truths*. They also include *verbal truths*—statements true by virtue of the meanings of their component words. (2) is a mathematical truth, (3) a verbal truth.

Are there other necessary truths? Are there necessary truths that are neither logically nor mathematically nor verbally true? That is a deep, debatable philosophical issue. Perhaps certain moral, metaphysical, or methodological principles ("One is obligated to do what one has promised," "Every event has a cause," "No hypothesis can be verified on the basis of a biased sample") count as necessary truths. I am not sure.

Sometimes the logical and verbal truths are lumped together under such rubrics as "analytic statements," "tautologies," and even "logical truths" (though not, of course, in my strictly formal sense).

Some falsehoods nevertheless are *possibly* true. A possible truth must, at the very least, be *consistent*. But some consistent statements fail to be possible truths in other ways.

Compare:

(5) There are nine planets.

(6) There are twelve planets.

(7) There are twelve apostles and nine planets and exactly as many planets as apostles.

(8) There are nonmale bachelors.

(9) There are nonmale males.

Being true, (5) automatically is *possibly* true. Although false, (6) is possibly true as well: there could have been twelve planets. (7)–(9) are not even possible truths. But of these, only (9) is inconsistent in the sense defined earlier. Only (9) is false by virtue of its logical form alone. It has the form:

There are non-M Ms,

and every statement of this form is false. But (7) and (8) have the respective forms:

There are t As and n Ps and exactly
as many As as Ps,

There are non-M Bs,

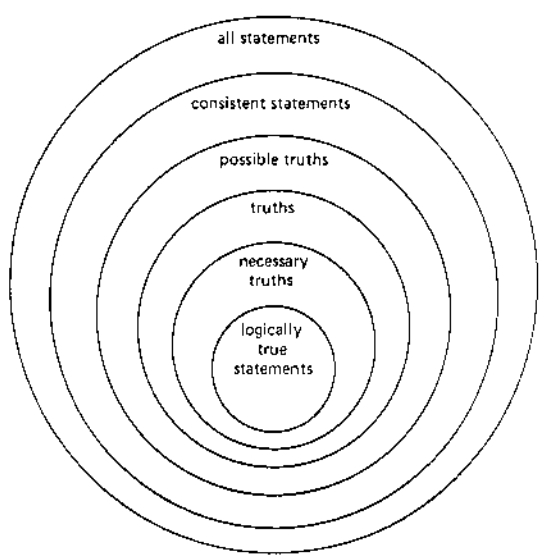
and some statements of these forms are true. (Find one each!)

Although consistent, (7) fails to be a possible truth because it is false on mathematical grounds, and (8) because it is verbally false—false by virtue of the meanings of its component words. Besides being consistent, a possible truth must not be mathematically or verbally false (although it can be false on other grounds, such as astronomical observation).

Necessity and possibility are interdefinable: A necessary truth is one that not only is true but cannot *possibly* be false. A possible truth is a statement which, even if false, is not *necessarily* false.

Very often, possible truths are called consistent (though in a narrower sense than mine), and statements that are not possibly true are called inconsistent (though in a broader sense than mine).

The categories I have been discussing are related to each other as follows:



Sometimes arguments are called valid, or their conclusions are said to follow from their premises, even though they are not valid in the narrow, strictly formal sense I have tried to explain. An argument is valid in the broader, nonformal sense so long as its premises would, if true, necessitate the truth of its conclusion—so long as it would be impossible for the premises to be true without the conclusion being true as well. This is the rough notion of validity introduced in §2.1 and polished to formal luster in §2.3.

Compare these four arguments:

(1) Ron is a Republican. Therefore, Ron is a cucumber.

(2) There are twelve apostles. And there are nine planets.
Therefore, there are more apostles than planets.

(3) Ignatz is someone's brother. Therefore, Ignatz is male.

(4) Bertha is a Democrat. But all Democrats are cucumbers.
Therefore, Bertha is a cucumber.

(1) is not valid in any sense: it is quite possible for its premises to be true without its conclusion being true. (2)–(4) are valid in the broad sense: in each case, it would be impossible for the premises to be true without the conclusion being true as well. But only (4) is valid in the narrow, formal sense. It has the form:

b is a D.

All Ds are Cs.

∴ b is a C.

and no argument of this form has both true premises and a false conclusion. By contrast, (2) and (3) have the respective forms:

There are t As.

There are n Ps.

∴ There are more As than Ps.

i is someone's B.

∴ i is M.

and some arguments of each of these forms have true premises plus false conclusions. That is, there are counter-examples to each form. (Stop and find a counter-example to each form!)

Adding the necessary truth "Twelve soandsos are always more than nine suchandsuches" to the premises of (2) makes (2) formally valid.

And adding the necessary truth "Every brother is male" to the premises of (3) makes (3) formally valid. In general, an argument that is valid in the broad sense (truth of premises would necessitate truth of conclusion) but not the narrow, formal sense (every argument of same form with true premises has true conclusion) can be made formally valid by adding one or more necessary truths to the premises. In real-life cases, such necessary truths can reasonably be regarded as tacit premises of the arguments in question, so those arguments can be regarded as formally valid.

EXERCISES

Depict the *logical forms* of the following arguments. In each case, if the argument is (formally) valid, write "VALID" (what else?). Do not bother to give a derivation. If the argument is not (formally) valid, write "INVALID," and prove invalidity by giving a counter-example to the invalid form—a genuine counter-example if possible, a near counter-example if that is the best you can do.

* 1. Any punishment that deters crime is justified. And capital punishment deters crime. So capital punishment is justified.

* 2. If capital punishment deterred crime, it would be justified. But it does not deter crime. So it is not justified.

3. No Albanian speaks with a proper Irish brogue. Consequently, whoever speaks with a proper Irish brogue is no Albanian.

4. Whoever has a great night life is a jet setter. But Count Dracula has a great night life. So Count Dracula is a jet setter.

* 5. If Count Dracula is a jet setter, then he has a great night life. Indeed, Count Dracula has a great night life. Thus, Count Dracula is a jet setter.

6. All Republicans are rich. But some politicians are not Republicans. So some politicians are not rich.

* 7. All policies recommended by the White House have some merit. But some energy policies do not have any merit. So some energy policies have not been recommended by the White House.

8. Either professors justify the way they spend their time, or the legislature has the right to impose work loads. But professors do not justify the way they spend their time. It follows that the legislature has the right to impose work loads.

* 9. Either we decontrol oil prices, or we deprive our posterity of energy sources, or both. But we indeed decontrol oil prices. Consequently, we do not deprive our posterity of energy sources.

10. If we have desires, we suffer from frustration. If we do not have desires, we suffer from boredom. Therefore, either we suffer from frustration, or we suffer from boredom. (Schopenhauer)

* 11. If we ratify the treaty, there will be resentment. But if we reject the treaty, there will be resentment. Therefore, there will be resentment.

12. If we ratify the treaty, there will be resentment. But if we reject the treaty, there will be resentment. And either we ratify the treaty or we reject it. Therefore, there will be resentment.

* 13. All Podunk students are smart. But some people are not smart. Therefore, some people are not Podunk students.

14. If we ratify the treaty, there will be resentment. But if we do not ratify the treaty, there will be resentment. Therefore, there will be resentment.

* 15. Homosexual acts involving only consenting adults have no victims. But every crime has a victim. Consequently, a homosexual act involving only consenting adults is no crime.

16. "Every person residing in Maine who earns less than $4,000 annually shall be furnished a hearing aid free of charge by the Department of Health and Welfare" (bill proposed in Maine Legislature, 1969, by Representative Robert Soulas of Bangor, cited in Pospesel, *Arguments*). Therefore, every person residing in Maine who has excellent hearing but earns less than $4,000 annually shall be furnished a hearing aid free of charge by the Department of Health and Welfare.

It is somewhat more difficult to display the logical forms of the following arguments, almost all of which are valid:

* 17. Standard IQ tests are culturally biased. But whatever is biased is discriminatory. And whatever is discriminatory is unconstitutional to use in public schools. So it is unconstitutional to use standard IQ tests in public schools.

18. Any woman who lives with a bunch of dwarfs must be a polyandrist. But polyandrists are married. And a married woman is entitled to maternity insurance. What's more, Snow White is a woman who lives with a bunch of dwarfs. Thus, Snow White is entitled to maternity insurance.

* 19. Everybody doesn't like somebody. Therefore, there is somebody everybody doesn't like.

20. No political partisan is unbiased about politics. But politics is what political-science professors teach. And most political-science professors are political partisans. Therefore, most political-science professors are biased about what they teach.

* 21. If something is outlawed, whoever does it is a criminal. So if owning guns is outlawed, only criminals own guns.

22. It is wrong to break the law. But to do what the law forbids is to break the law. And a law is just if it forbids only what is wrong. Consequently, every law is just.

23. All countries that automatically behead convicted murderers have fewer assassinations in a century than the U.S. has in one year. But any country that has fewer assassinations in a century than the U.S. has in one year has a positive contribution to make to the U.S. criminal-justice system. And no country that has such a contribution to make should be judged offhandedly to be barbarous. So no country that automatically beheads convicted murderers should be judged offhandedly to be barbarous.

* 24. Believing in God amounts to high potential gain and no chance of loss. And not believing in God amounts to high potential loss and no chance of gain. But high potential gain and no chance of loss is safer than high potential loss and no chance of gain. So believing in God is safer than not believing in God. (Pascal's "Wager")

* 25. If there is no morally relevant difference between two things and if one is wrong, so is the other. But there is no morally relevant difference between banning *Hustler* and banning *T.V. Guide*. Therefore, because it would be wrong to ban *T.V. Guide*, it would be wrong to ban *Hustler*.

* 26. If a thing does not exist in reality, then something greater than it can be conceived. But nothing greater than any god can be conceived. So some god exists in reality.

27. If we decontrol natural-gas prices, we place an unfair burden on the poor. But if we do not decontrol natural-gas prices, we impose unjust costs on future generations. Therefore, either we place an unfair burden on the poor, or we impose unjust costs on future generations.

* 28. If we fail to control population growth, the world will become over-crowded. But if we control population growth, we interfere with individual liberty. So if we do not interfere with individual liberty, the world will become over-crowded.

29. Either we decrease government spending, or we increase inflation. But if we decrease government spending, we increase unemployment. And if we increase inflation, we hurt those with fixed incomes. So we must increase unemployment or hurt those with fixed incomes.

* 30. Either God does not want to prevent evil, or God cannot prevent evil. But if God does not want to prevent evil, then God is not benevolent. And if God cannot prevent evil, then God is not omnipotent. Therefore, God is not both benevolent and omnipotent.

* 31. You cannot fool all the people all the time. Therefore, there is a person whom you can never fool.

* 32. God exists in the imagination. If a thing exists in the imagination but not in reality, something greater than it can be conceived. But nothing greater than God can be conceived. Therefore, God exists in reality.

33. Millard Fillmore is dead. So either the Captains Regent of San Marino will decide to devastate Liechtenstein with a neutron bomb delivered by the Goodyear Blimp, or they will not.

34. It is both raining and not raining. So 2 + 2 = 3.

For each of the following *statements*, say whether it is LOGICALLY TRUE and whether it is CONSISTENT. Also say whether it is NECESSARILY TRUE and whether it is POSSIBLY TRUE. If it is consistent, prove it so by citing a true statement of the same logical form. If it is not logically true, prove this by citing a false statement of the same logical form.

* 35. It is raining champagne.

* 36. It is or is not raining champagne.

* 37. It never rains champagne.

* 38. It is and is not raining champagne.

* 39. Whenever it rains champagne, it rains wine.

40. Every square has four sides.

41. 7 + 5 = 13.

42. Every sister is a sibling.

* 43. Red is a color.

44. Some sister is a sibling.

* 45. Everyone is such that, if he is a sibling, then someone is a sibling.

46. Some sister is not a sibling.

47. It is not raining champagne or not raining Pabst Blue Ribbon if, and only if, it is not the case that it is both raining champagne and raining Pabst Blue Ribbon.

48. If Abyssinia started and lost World War II, then Abyssinia lost World War II and started World War II.

49. Some square has just three corners.

* 50. The man who shaves all and only those men who do not shave themselves shaves himself if, and only if, he does not shave himself.

* 51. There is a man who shaves all and only those men who do not shave themselves.