Chapter 4: Categorical Propositions
(pp. 197-258)

Categorical Propositions: Chapter Overview

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4.1 The Components of Categorical Propositions

In Chapter 1 we saw that a proposition (or statement—here we are ignoring the distinction) is a sentence that is either true or false. A proposition that relates two classes, or categories, is called a categorical proposition. The classes in question are denoted respectively by the subject term and the predicate term, and the proposition asserts that either all or part of the class denoted by the subject term is included in or excluded from the class denoted by the predicate term. Here are some examples of categorical propositions:

*American Idol* contestants hope for recognition.
Junk foods do not belong in school cafeterias.
Many of today's unemployed have given up on finding work.
Not all romances have a happy ending.
Oprah Winfrey publishes magazines.

The first statement asserts that the entire class of *American Idol* contestants is included in the class of people who hope for recognition, the second that the entire class of junk foods is excluded from the class of things that belong in school cafeterias, and

the third that part of the class of today's unemployed people is included in the class of people who have given up on finding work. The fourth statement asserts that part of the class of romances is excluded from the class of things that have a happy ending, and the last statement asserts that the class that has Oprah Winfrey as its single member is included in the class of people who publish magazines.

Since any categorical proposition asserts that either all or part of the class denoted by the subject term is included in or excluded from the class denoted by the predicate term, it follows that there are exactly four types of categorical propositions:

(1) those that assert that the whole subject class is included in the predicate class, (2) those that assert that part of the subject class is included in the predicate class, (3) those that assert that the whole subject class is excluded from the predicate class, and (4) those that assert that part of the subject class is excluded from the predicate class. A categorical proposition that expresses these relations with complete clarity is called a **standard-form categorical proposition**. A categorical proposition is in standard form if and only if it is a substitution instance of one of the following four forms:

\[
\begin{align*}
\text{All } S & \text{ are } P. \\
\text{No } S & \text{ are } P. \\
\text{Some } S & \text{ are } P. \\
\text{Some } S & \text{ are not } P.
\end{align*}
\]

Many categorical propositions, of course, are not in standard form because, among other things, they do not begin with the words “all,” “no,” or “some.” In the final section of this chapter we will develop techniques for translating categorical propositions into standard form, but for now we may restrict our attention to those that are already in standard form.

The words “all,” “no,” and “some” are called **quantifiers** because they specify how much of the subject class is included in or excluded from the predicate class. The first form asserts that the whole subject class is included in the predicate class, the second that the whole subject class is excluded from the predicate class, and so on. (Incidentally, in formal deductive logic the word “some” always means at least one.) The letters \( S \) and \( P \) stand respectively for the subject and predicate terms, and the words “are” and “are not” are called the **copula** because they link (or “couple”) the subject term with the predicate term.

Consider the following example:

All members of the American Medical Association are people holding degrees from recognized academic institutions.

This standard-form categorical proposition is analyzed as follows:

| quantifier: | all |
| subject term: | members of the American Medical Association |
| copula: | are |
| predicate term: | people holding degrees from recognized academic institutions |

In resolving standard-form categorical propositions into their four components, one must keep these components separate. They do not overlap. In this regard, note that “subject term” and “predicate term” do not mean the same thing in logic that “subject” and “predicate” mean in grammar. The **subject** of the example statement includes the
University in Decatur and graduate with a major in mathematics and philosophy. After earning a Ph.D. in philosophy from the University of Wisconsin, where she worked on Whitehead and Russell's *Principia Mathematica*, she entered a postdoctoral program at Cambridge University. There she studied under, and became a close disciple of, the famous philosopher Ludwig Wittgenstein, and she received a second Ph.D. from that university in 1938. In 1937 she accepted a teaching position in philosophy at Smith College, where she remained until her retirement in 1972.

Within a year after arriving at Smith, Ambrose met and married the philosopher Morris Lazerowitz, with whom she coauthored several books and articles. One was a textbook in symbolic logic, commonly called “Ambrose and Lazerowitz” that was used by a generation of young philosophers. Other subjects on which Ambrose did important work include the foundations of mathematics, finitism in mathematics, logical impossibility, the justification of induction, and Wittgenstein's theory of proof. Ambrose was a particularly lucid writer, and this, combined with her keen insight, won widespread recognition by philosophers and logicians.

From 1975 to 1976 Ambrose served as president of the American Philosophical Association (Eastern Division). Interestingly, in that office she was immediately preceded by John Rawls, and immediately succeeded by Hillary Putnam. Ambrose was also a dedicated supporter of peace and social justice, and she remained active as a speaker and writer until her death in 2001 at the age of 94. Today Smith College sponsors an annual address in her honor.

Two additional points should be noted about standard-form categorical propositions. The first is that the form “All S are not P” is not a standard form. This form is ambiguous and can be rendered as either “No S are P” or “Some S are not P,” depending on the content. The second point is that there are exactly three forms of quantifiers and two forms of copulas. Other texts allow the various forms of the verb “to be” (such as “is,” “is not,” “will,” and “will not”) to serve as the copula. For the sake of uniformity, this book restricts the copula to “are” and “are not.” The last section of this chapter describes techniques for translating these alternate forms into the two accepted ones.

Originated by Aristotle, the theory of categorical propositions has constituted one of the core topics in logic for over 2,000 years. It remains important even today because many of the statements we make in ordinary discourse are either categorical propositions as they stand or are readily translatable into them. Standard-form categorical propositions represent an ideal of clarity in language, and a familiarity with the relationships that prevail among them provides a backdrop of precision for all kinds of linguistic usage. In Chapter 5 we will see how categorical propositions may be combined to produce categorical syllogisms, a kind of argumentation that is closely related to the most basic forms of human reasoning.

Exercise 4.1

In the following categorical propositions identify the quantifier, subject term, copula, and predicate term.
1. Some executive pay packages are insults to ordinary workers.

2. No stressful jobs are occupations conducive to a healthy lifestyle.

3. All oil-based paints are products that contribute to photochemical smog.

4. Some preachers who are intolerant of others' beliefs are not television evangelists.

5. All trials in which a coerced confession is read to the jury are trials in which a guilty verdict can be reversed.

6. Some artificial hearts are mechanisms that are prone to failure.

7. No sex education courses that are taught competently are programs that are currently eroding public morals.

8. Some universities that emphasize research are not institutions that neglect undergraduate education.

4.2 Quality, Quantity, and Distribution

Quality and quantity are attributes of categorical propositions. In order to see how these attributes pertain, it is useful to rephrase the meaning of categorical propositions in class terminology:

<table>
<thead>
<tr>
<th>Proposition</th>
<th>Meaning in class notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>All $S$ are $P$.</td>
<td>Every member of the $S$ class is a member of the $P$ class;</td>
</tr>
<tr>
<td></td>
<td>that is, the $S$ class is included in the $P$ class.</td>
</tr>
<tr>
<td>No $S$ are $P$.</td>
<td>No member of the $S$ class is a member of the $P$ class;</td>
</tr>
<tr>
<td></td>
<td>that is, the $S$ class is excluded from the $P$ class.</td>
</tr>
<tr>
<td>Some $S$ are $P$.</td>
<td>At least one member of the $S$ class is a member of the $P$ class.</td>
</tr>
<tr>
<td>Some $S$ are not $P$.</td>
<td>At least one member of the $S$ class is not a member of the $P$ class.</td>
</tr>
</tbody>
</table>

The quality of a categorical proposition is either affirmative or negative depending on whether it affirms or denies class membership. Accordingly, “All $S$ are $P$” and “Some $S$ are $P$” have affirmative quality, and “No $S$ are $P$” and “Some $S$ are not $P$” have negative quality. These are called affirmative propositions and negative propositions, respectively.

The quantity of a categorical proposition is either universal or particular, depending on whether the statement makes a claim about every member or just some member of the class denoted by the subject term. “All $S$ are $P$” and “No $S$ are $P$” each assert something about every member of the $S$ class and thus are universal propositions. “Some $S$ are $P$” and “Some $S$ are not $P$” assert something about one or more members of the $S$ class and hence are particular propositions.

Note that the quantity of a categorical proposition may be determined through mere inspection of the quantifier. “All” and “no” immediately imply universal quantity, while “some” implies particular. But categorical propositions have no “qualifier.” In universal propositions the quality is determined by the quantifier, and in particular propositions it is determined by the copula.

Particular propositions mean no more and no less than the meaning assigned to them in class notation. The statement “Some $S$ are $P$” does not imply that some $S$ are not $P$, and the statement “Some $S$ are not $P$” does not imply that some $S$ are $P$. It often happens, of course, that substitution instances of these statement forms are both true. For example, “Some apples are red” is true, as is “Some apples are not red.” But the fact that one is true does not necessitate that the other be true. “Some zebras are animals” is true (because at least one zebra is an animal), but “Some zebras are not animals” is false. Similarly, “Some turkeys are not fish” is true, but “Some turkeys are fish” is false. Thus, the fact that one of these statement forms is true does not logically imply that the other is true, as these substitution instances clearly prove.

Since the early Middle Ages the four kinds of categorical propositions have commonly been designated by letter names corresponding to the first four vowels of the Roman alphabet: A, E, I, O. The universal affirmative is called an A proposition, the universal negative an E proposition, the particular affirmative an I proposition, and the particular negative an O proposition. Tradition has it that these letters were derived from the first two vowels in the Latin words affirmo (“I affirm”) and nego (“I deny”), thus:
The material presented thus far in this section may be summarized as follows:

<table>
<thead>
<tr>
<th>Proposition</th>
<th>Letter name</th>
<th>Quantity</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>All $S$ are $P$.</td>
<td>$A$</td>
<td>universal</td>
<td>affirmative</td>
</tr>
<tr>
<td>No $S$ are $P$.</td>
<td>$E$</td>
<td>universal</td>
<td>negative</td>
</tr>
<tr>
<td>Some $S$ are $P$.</td>
<td>$I$</td>
<td>particular</td>
<td>affirmative</td>
</tr>
<tr>
<td>Some $S$ are not $P$.</td>
<td>$O$</td>
<td>particular</td>
<td>negative</td>
</tr>
</tbody>
</table>

Unlike quality and quantity, which are attributes of propositions, distribution is an attribute of the terms (subject and predicate) of propositions. A term is said to be distributed if the proposition makes an assertion about every member of the class denoted by the term; otherwise, it is undistributed. Stated another way, a term is distributed if and only if the statement assigns (or distributes) an attribute to every member of the class denoted by the term. Thus, if a statement asserts something about every member of the $S$ class, then $S$ is distributed; if it asserts something about every member of the $P$ class, then $P$ is distributed; otherwise $S$ and $P$ are undistributed.

Let us imagine that the members of the classes denoted by the subject and predicate terms of a categorical proposition are contained respectively in circles marked with the letters “$S$” and “$P$.” The meaning of the statement form “All $S$ are $P$” may then be represented by the following diagram:

![Diagram of S and P circles with S inside P]

The $S$ circle is contained in the $P$ circle, which represents the fact that every member of $S$ is a member of $P$. (Of course, should $S$ and $P$ represent terms denoting identical classes, the two circles would overlap exactly.) As the diagram shows, “All $S$ are $P$” makes a claim about every member of the $S$ class, since the statement says that every member of $S$ is in the $P$ class. But the statement does not make a claim about every member of the $P$ class, since there may be some members of $P$ that are outside of $S$. Thus, by the definition of “distributed term” given above, $S$ is distributed and $P$ is not. In other words, for any universal affirmative ($A$) proposition, the subject term, whatever it may be, is distributed, and the predicate term is undistributed.

Let us now consider the universal negative ($E$) proposition. “No $S$ are $P$” states that the $S$ and $P$ classes are separate, which may be represented as follows:

![Diagram of S and P circles with S and P separate]

This statement makes a claim about every member of $S$ and every member of $P$. It asserts that every member of $S$ is separate
from every member of $P$, and also that every

member of $P$ is separate from every member of $S$. Accordingly, by our definition, both the subject and predicate terms of universal negative (E) propositions are distributed.

The particular affirmative (I) proposition states that at least one member of $S$ is a member of $P$. If we represent this one member of $S$ that we are certain about by an asterisk, the resulting diagram looks like this:

```
* S

P
```

Since the asterisk is inside the $P$ class, it represents something that is simultaneously an $S$ and a $P$; in other words, it represents a member of the $S$ class that is also a member of the $P$ class. Thus, the statement “Some $S$ are $P$” makes a claim about one member (at least) of $S$ and also one member (at least) of $P$, but not about all members of either class. Hence, by the definition of distribution, neither $S$ nor $P$ is distributed.

The particular negative (O) proposition asserts that at least one member of $S$ is not a member of $P$. If we once again represent this one member of $S$ by an asterisk, the resulting diagram is as follows:

```
* S

P
```

Since the other members of $S$ may or may not be outside of $P$, it is clear that the statement “Some $S$ are not $P$” does not make a claim about every member of $S$, so $S$ is not distributed. But, as may be seen from the diagram, the statement does assert that every member of $P$ is separate and distinct from this one member of $S$ that is outside the $P$ circle. Thus, in the particular negative (O) proposition, $P$ is distributed and $S$ is undistributed.

At this point the notion of distribution may be somewhat vague and elusive. Unfortunately, there is no simple and easy way to make the idea graphically clear. The best that can be done is to repeat some of the things that have already been said. First of all, distribution is an attribute or quality that the subject and predicate terms of a categorical proposition may or may not possess, depending on the kind of proposition. If the proposition in question is an A type, then the subject term, whatever it may be, is distributed. If it is an E type, then both terms are distributed; if an I type, then neither; and if an O type, then the predicate. If a certain term is distributed in a proposition, this simply means that the proposition says something about every member of the class that the term denotes. If a term is undistributed, the proposition does not say something about every member of the class.

An easy way to remember the rule for distribution is to keep in mind that universal (A and E) statements distribute their subject terms and negative (E and O) statements distribute their predicate terms. As an aid to remembering this arrangement, the following mnemonic may be useful: “Unprepared Students Never Pass.” Attending to

the first letter in these words may help one recall that Universals distribute Subjects, and Negatives distribute Predicates. Another mnemonic that accomplishes the same purpose is “Any Student Earning B’s Is Not On Probation.” In this mnemonic the first letters may help one recall that A statements distribute the Subject, E statements distribute Both terms, I statements distribute Neither term, and O statements distribute the Predicate.

<table>
<thead>
<tr>
<th>Two mnemonic devices for distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Unprepared Students Never Pass”</td>
</tr>
<tr>
<td>“Any Student Earning B’s Is Not On Probation”</td>
</tr>
<tr>
<td>Universals distribute Subjects.</td>
</tr>
<tr>
<td>A distributes Subject.</td>
</tr>
<tr>
<td>Negatives distribute Predicates.</td>
</tr>
<tr>
<td>E distributes Both.</td>
</tr>
</tbody>
</table>
Finally, note that the attribute of distribution, while not particularly important to subsequent developments in this chapter, is essential to the evaluation of syllogisms in the next chapter.

The material of this section may now be summarized as follows:

<table>
<thead>
<tr>
<th>Proposition</th>
<th>Letter name</th>
<th>Quantity</th>
<th>Quality</th>
<th>Terms distributed</th>
</tr>
</thead>
<tbody>
<tr>
<td>All $S$ are $P$.</td>
<td>$A$</td>
<td>universal</td>
<td>affirmative</td>
<td>$S$</td>
</tr>
<tr>
<td>No $S$ are $P$.</td>
<td>$E$</td>
<td>universal</td>
<td>negative</td>
<td>$S$ and $P$</td>
</tr>
<tr>
<td>Some $S$ are $P$.</td>
<td>$I$</td>
<td>particular</td>
<td>affirmative</td>
<td>none</td>
</tr>
<tr>
<td>Some $S$ are not $P$.</td>
<td>$O$</td>
<td>particular</td>
<td>negative</td>
<td>$P$</td>
</tr>
</tbody>
</table>

**Exercise 4.2**

I. For each of the following categorical propositions identify the letter name, quantity, and quality. Then state whether the subject and predicate terms are distributed or undistributed.

1. No vampire movies are films without blood.
2. All governments that bargain with terrorists are governments that encourage terrorism.
3. Some symphony orchestras are organizations on the brink of bankruptcy.
4. Some Chinese leaders are not thoroughgoing opponents of capitalist economics.
5. All human contacts with benzene are potential causes of cancer.
6. No labor strikes are events welcomed by management.
7. Some hospitals are organizations that overcharge the Medicare program.
8. Some affirmative action plans are not programs that result in reverse discrimination.

II. Change the quality but not the quantity of the following statements.

1. All drunk drivers are threats to others on the highway.
2. No wildlife refuges are locations suitable for condominium developments.
3. Some slumlords are people who eventually wind up in jail.
4. Some CIA operatives are not champions of human rights.

III. Change the quantity but not the quality of the following statements.

1. All owners of pit bull terriers are people who can expect expensive lawsuits.
2. No tax proposals that favor the rich are fair proposals.
3. Some grade school administrators are people who choke the educational process.
4. Some residents of Manhattan are not people who can afford to live there.
IV. Change both the quality and the quantity of the following statements.

1. All oil spills are events catastrophic to the environment.
2. No alcoholics are people with a healthy diet.
3. Some Mexican vacations are episodes that end with gastrointestinal distress.
4. Some corporate lawyers are not people with a social conscience.

4.3 Venn Diagrams and the Modern Square of Opposition

Existential Import

The primary goal of our inquiry into categorical propositions is to disclose the role that such propositions play in the formation of arguments. However, it turns out that we can interpret universal (A and E) propositions in two different ways, and according to one of these interpretations an argument might be valid, while according to the other it might be invalid. Thus, before turning to the evaluation of arguments, we must explore the two possible interpretations of universal propositions. Our investigation will focus on what is called existential import. To illustrate this concept, consider the following pair of propositions:

All Tom Cruise's movies are hits.
All unicorns are one-horned animals.

The first proposition implies that Tom Cruise has indeed made some movies. In other words, the statement has existential import. It implies that one or more things denoted by the subject term actually exist. On the other hand, no such implication is made by the statement about unicorns. The statement is true, because unicorns, by definition, have a single horn. But the statement does not imply that unicorns actually exist.

Thus, the question arises: Should universal propositions be interpreted as implying that the things talked about actually exist? Or should they be interpreted as implying no such thing? In response to this question, logicians have taken two different approaches. Aristotle held that universal propositions about existing things have existential import. In other words, such statements imply the existence of the things talked about:

<table>
<thead>
<tr>
<th>Aristotelian standpoint</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All pheasants are birds.</td>
<td>Implies the existence of pheasants.</td>
</tr>
<tr>
<td>No pine trees are maples.</td>
<td>Implies the existence of pine trees.</td>
</tr>
<tr>
<td>All satyrs are vile creatures.</td>
<td>Does not imply the existence of satyrs.</td>
</tr>
</tbody>
</table>

The first two statements have existential import because their subject terms denote actually existing things. The third statement has no existential import, because satyrs do not exist.

On the other hand, the nineteenth-century logician George Boole held that no universal propositions have existential import. Such statements never imply the existence of the things talked about:

<table>
<thead>
<tr>
<th>Boolean standpoint</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All trucks are vehicles.</td>
<td>Does not imply the existence of trucks.</td>
</tr>
<tr>
<td>No roses are daisies.</td>
<td>Does not imply the existence of roses.</td>
</tr>
<tr>
<td>All werewolves are monsters.</td>
<td>Does not imply the existence of werewolves.</td>
</tr>
</tbody>
</table>

We might summarize these results by saying that the Aristotelian standpoint is “open” to existence.* When things exist, the Aristotelian standpoint recognizes their existence, and universal statements about those things have existential import. In other words, existence counts for something. On the other hand, the Boolean standpoint is “closed” to existence. When things exist, the Boolean standpoint does not recognize their existence, and universal statements about those things have no
existential import.

Eminent Logicians: George Boole 1815–1864

The English mathematician and philosopher George Boole is known primarily for the development of Boolean algebra—a type of logic based on the three fundamental operation of and, or, and not. The American logician Charles Sanders Peirce was captivated by Boole's ideas, and he saw a possible application in the area of electrical circuitry. One of Peirce's students, Claude Shannon, actually succeeded in putting theory to practice when he showed how Boole's system could be used in designing telephone routing switches. This innovation subsequently led to the development of electronic digital computers.

Boole's early years were marked by struggle. His father, John, was a cobbler, and his mother, Mary Ann, a lady's maid. They could afford only the most basic education for their son, which John supplemented by teaching mathematics and science to young George and by hiring a Latin tutor for him. Boole taught himself Greek, French, and German. His father, a leading member of the Mechanics Institute, was intrigued by the application of mathematics in making instruments, and he passed this interest to his son. Though poverty limited the resources available to him, Boole used mathematics journals borrowed from the institute to further his mathematics education on his own.

When George was only sixteen, his father's shoemaking business folded, and it fell to him to support the family by working as an assistant teacher. When he was twenty-two, he took over the operation of a boarding school after its former director had died, and his whole family assisted him in running it. Throughout this period, Boole continued his study of mathematics, and at age twenty-nine he published a paper on the use of algebraic methods in solving differential equations. In recognition of this work he received the Royal Society Medal, which brought him considerable fame in the mathematical world.

Three years later Boole published The Mathematical Analysis of Logic, which brought to fruition some of Leibniz's earlier speculations on the relationship between mathematics and logic. It also showed how the symbolism of mathematics could be imported into logic. This work won him a professorship at Queens College, in Cork, Ireland, where he remained for the rest of his life. Seven years later he published a much larger and more mature work on the same subject, An Investigation of the Laws of Thought, on Which Are Founded the Mathematical Theories of Logic and Probabilities. This later work presented a complete system of symbolic reasoning.

Boole married Mary Everest (the niece of Sir George Everest, after whom Mt. Everest is named). He met her when she came to visit her famous uncle in Cork, and the relationship developed through his giving her lessons on differential equations. The couple had five daughters, but when Boole was only forty-nine his life was cut short from what was probably pneumonia. Boole had walked two miles in the pouring rain to lecture at Queens, and he delivered the lecture in wet clothing. After he developed a high fever and became desperately ill, his wife, thinking that a good cure always mirrors the cause, poured cold water on him as he lay in bed. He died shortly thereafter.
The Aristotelian standpoint differs from the Boolean standpoint only with regard to universal (A and E) propositions. The two standpoints are identical with regard to particular (I and O) propositions. Both the Aristotelian and the Boolean standpoints recognize that particular propositions make a positive assertion about existence. For example, from both standpoints, the statement “Some cats are animals” asserts that at least one cat exists, and that cat is an animal. Also, from both standpoints, “Some fish are not mammals” asserts that at least one fish exists, and that fish is not a mammal. Thus, from both standpoints, the word “some” implies existence.†

Adopting either the Aristotelian or the Boolean standpoint amounts to accepting a set of ground rules for interpreting the meaning of universal propositions. Either standpoint can be adopted for any categorical proposition or any argument composed of categorical propositions. Taking the Aristotelian standpoint amounts to recognizing that universal statements about existing things convey evidence about existence. Conversely, for a statement to convey such evidence, the Aristotelian standpoint must be taken and the subject of the statement must denote actually existing things. Taking the Boolean standpoint, on the other hand, amounts to ignoring any evidence about existence that universal statements might convey.

Because the Boolean standpoint is closed to existence, it is simpler than the Aristotelian standpoint, which recognizes existential implications. For this reason, we will direct our attention first to arguments considered from the Boolean standpoint. Later, in Section 4.5, we will extend our treatment to the Aristotelian standpoint.

**Venn Diagrams**

From the Boolean standpoint, the four kinds of categorical propositions have the following meaning. Notice that the first two (universal) propositions imply nothing about the existence of the things denoted by S:

- All S are P. = No members of S are outside P.
- No S are P. = No members of S are inside P.
- Some S are P. = At least one S exists, and that S is a P.
- Some S are not P. = At least one S exists, and that S is not a P.

Adopting this interpretation of categorical propositions, the nineteenth-century logician John Venn developed a system of diagrams to represent the information they express. These diagrams have come to be known as Venn diagrams.

A Venn diagram is an arrangement of overlapping circles in which each circle represents the class denoted by a term in a categorical proposition. Because every categorical proposition has exactly two terms, the Venn diagram for a single categorical proposition consists of two overlapping circles. Each circle is labeled so that it represents one of the terms in the proposition. Unless otherwise required, we adopt the convention that the left-hand circle represents the subject term, and the right-hand circle the predicate term. Such a diagram looks like this:

The members of the class denoted by each term should be thought of as situated inside the corresponding circle. Thus, the members of the S class (if any such members exist) are situated inside the S circle, and the members of the P class (if any such members exist) are situated inside the P circle. If any members are situated inside the area where the two circles overlap, then such members belong to both the S class and the P class. Finally, if any members are situated outside both circles, they are members of neither S nor P.

Suppose, for example, that the S class is the class of Americans and the P class is the class of farmers. Then, if we use numerals to identify the four possible areas, the diagram looks like this:
Anything in the area marked “1” is an American but not a farmer, anything in the area marked “2” is both an American and a farmer, and anything in the area marked “3” is a farmer but not an American. The area marked “4” is the area outside both circles; thus, anything in this area is neither a farmer nor an American.

We can now use Venn diagrams to represent the information expressed by the four kinds of categorical proposition. To do this we make a certain kind of mark in a diagram. Two kinds of marks are used: shading an area and placing an X in an area. Shading an area means that the shaded area is empty, * and placing an X in an area means that at least one thing exists in that area. The X may be thought of as representing that one thing. If no mark appears in an area, this means that nothing is known about that area; it may contain members or it may be empty. Shading is always used to represent the content of universal (A and E) propositions, and placing an X in an area is always used to represent the content of particular (I and O) propositions. The content of the four kinds of categorical propositions is represented as follows:

<table>
<thead>
<tr>
<th>Proposition</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: All S are P.</td>
<td>![Diagram A]</td>
</tr>
<tr>
<td>E: No S are P.</td>
<td>![Diagram E]</td>
</tr>
<tr>
<td>I: Some S are P.</td>
<td>![Diagram I]</td>
</tr>
<tr>
<td>O: Some S are not P.</td>
<td>![Diagram O]</td>
</tr>
</tbody>
</table>

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Recall that the A proposition asserts that no members of S are outside P. This is represented by shading the part of the S circle that lies outside the P circle. The E proposition asserts that no members of S are inside P. This is represented by shading the part of the S circle that lies inside the P circle. The I proposition asserts that at least one S exists and that S is also a P. This is represented by placing an X in the area where the S and P circles overlap. This X represents an existing thing that is both an S and a P. Finally, the O proposition asserts that at least one S exists, and that S is not a P. This is represented by placing an X in the part of the S circle that lies outside the P circle. This X represents an existing thing that is an S but not a P.

Because there is no X in the diagrams that represent the universal propositions, these diagrams say nothing about existence. For example, the diagram for the A proposition merely asserts that nothing exists in the part of the S circle that lies outside the P circle. The area where the two circles overlap and the part of the P circle that lies outside the S circle contain no marks at all. This means that something might exist in these areas, or they might be completely empty. Similarly, in the diagram for the E proposition, no marks appear in the left-hand part of the S circle and the right-hand part of the P circle. This means that these two areas might contain something or, on the other hand, they might not.

The Modern Square of Opposition

Let us compare the diagram for the A proposition with the diagram for the O proposition. The diagram for the A proposition asserts that the left-hand part of the S circle is empty, whereas the diagram for the O proposition asserts that this same area is not empty. These two diagrams make assertions that are the exact opposite of each other. As a result, their corresponding statements are said to contradict each other. Analogously, the diagram for the E proposition asserts that the area where the two circles overlap is empty, whereas the diagram for the I proposition asserts that the area where the two circles overlap is not empty. Accordingly, their corresponding propositions are also said to contradict each other. This relationship of mutually contradictory pairs of propositions is represented in a diagram called the modern square of opposition. This diagram, which arises from the modern (or Boolean) interpretation of categorical propositions, is represented as follows:

![Modern Square of Opposition Diagram](image)

If two propositions are related by the contradictory relation, they necessarily have opposite truth value. Thus, if a certain A proposition is given as true, the corresponding O proposition must be false. Similarly, if a certain I proposition is given as false, the corresponding E proposition must be true. But no other inferences are possible. In particular, given the truth value of an A or O proposition, nothing can be determined about the truth value of the corresponding E or I propositions. These propositions are said to have logically undetermined truth value. Like all propositions, they do have a truth value, but logic alone cannot determine what it is. Similarly, given the truth value of an E or I proposition, nothing can be determined about the truth value of the corresponding A or O propositions. They, too, are said to have logically undetermined truth value.

Testing Immediate Inferences

Since the modern square of opposition provides logically necessary results, we can use it to test certain arguments for validity. We begin by assuming the premise is true, and we enter the pertinent truth value in the square. We then use the square to compute the truth value of the conclusion. If the square indicates that the conclusion is true, the argument is valid; if not, the argument is invalid. Here is an example:
Some trade spies are not masters at bribery. Therefore, it is false that all trade spies are masters at bribery.

Arguments of this sort are called **immediate inferences** because they have only one premise. Instead of reasoning from one premise to the next, and then to the conclusion, we proceed immediately to the conclusion. To test this argument for validity, we begin by assuming that the premise, which is an **O** proposition, is true, and we enter this truth value in the square of opposition. We then use the square to compute the truth value of the corresponding **A** proposition. By the contradictory relation, the **A** proposition is false. Since the conclusion claims that the **A** proposition is false, the conclusion is true, and therefore the argument is valid. Arguments that are valid from the Boolean standpoint are said to be **unconditionally valid** because they are valid regardless of whether their terms refer to existing things.

Note that the conclusion of this argument has the form “It is false that all **S** are **P**.” Technically, statements of this type are not standard-form propositions because, among other things, they do not begin with a quantifier. To remedy this difficulty we adopt the convention that statements having this form are equivalent to “‘All **S** are **P**’ is false.” Analogous remarks apply to the negations of the **E**, **I**, and **O** statements.

Here is another example:

It is false that all meteor showers are common spectacles. Therefore, no meteor showers are common spectacles.

We begin by assuming that the premise is true. Since the premise claims that an **A** proposition is false, we enter “false” into the square of opposition. We then use the square to compute the truth value of the corresponding **E** proposition. Since there is no relation that links the **A** and **E** propositions, the **E** proposition has undetermined truth value. Thus, the conclusion of the argument has undetermined truth value, and the argument is invalid.

We can also use Venn diagrams to test immediate inferences for validity. However, using this technique often requires that we diagram statements beginning with the phrase “It is false that.” Let us begin by showing how to diagram such statements. Here are two examples:

- It is false that all **A** are **B**.  
- It is false that some **A** are **B**.

The first statement claims that “All **A** are **B**” is false. Thus, to diagram it, we do the exact opposite of what we would do to diagram “All **A** are **B**.” To diagram “All **A** are **B**,” we shade the left-hand part of the **A** circle:

```
All A are B.
```

To diagram “It is false that all **A** are **B**,” we enter an **X** in the left-hand part of the **A** circle. Entering an **X** in an area is the opposite of shading an area:
Any statement that is diagrammed by entering an X in an area is a particular proposition. Thus, as the diagram shows, “It is false that all A are B” is actually a particular proposition. By similar reasoning, “It is false that no A are B” is also a particular proposition.

To diagram “It is false that some A are B,” we do the exact opposite of what we would do to diagram “Some A are B.” For “Some A are B,” we would enter an X in the overlap area. Thus, to diagram “It is false that some A are B,” we shade the overlap area:

![Venn Diagram](image1)

Any statement that is diagrammed by shading an area is a universal proposition. Thus, “It is false that some A are B” is actually a universal proposition. By similar reasoning, “It is false that some A are not B” is also a universal proposition.

Now let us use Venn diagrams to test an immediate inference. To do so we begin by using letters to represent the terms, and we then draw Venn diagrams for the premise and conclusion. If the information expressed by the conclusion diagram is contained in the premise diagram, the argument is valid; if not, it is invalid. Here is the symbolized form of the trade spies inference that we tested earlier.

\[
\text{Some } T \text{ are not } M. \\
\text{Therefore, it is false that all } T \text{ are } M.
\]

The next step is to draw two Venn diagrams, one for the premise and the other for the conclusion. For the premise we enter an X in the left-hand part of the T circle, and for the conclusion, as we have just seen, we enter an X in the left-hand part of the T circle:

![Venn Diagram](image2)
To evaluate the inference, we look to see whether the information expressed by the conclusion diagram is also expressed by the premise diagram. The conclusion diagram asserts that something exists in the left-hand part of the $T$ circle. Since this information is also expressed by the premise diagram, the inference is valid. In this case, the diagram for the conclusion is identical to the diagram for the premise, so it is clear that premise and conclusion assert exactly the same thing. However, as we will see in Sections 4.5 and 4.6, for an immediate inference to be valid, it is not necessary that premise and conclusion assert exactly the same thing. It is only necessary that the premise assert \textit{at least as much} as the conclusion.

Here is the symbolized version of the second inference evaluated earlier:

\begin{align*}
\text{It is false that all } M &\text{ are } C. \\
\text{Therefore, no } M &\text{ are } C.
\end{align*}

To diagram the premise, we enter an X in the left-hand part of the $M$ circle, and for the conclusion we shade the overlap area:

\begin{itemize}
\item It is false that all $M$ are $C$. \\
\begin{tikzpicture}
\draw[fill=white] (0,0) circle (1cm);
\filldraw (0,0) circle (0.2cm) node{X};
\filldraw (-1,0) circle (0.2cm);
\draw[fill=white] (1,0) circle (1cm);
\end{tikzpicture}
\item No $M$ are $C$. \\
\begin{tikzpicture}
\draw[fill=white] (0,0) circle (1cm);
\filldraw (0,0) circle (0.2cm);
\draw[fill=white] (-1,0) circle (1cm);
\end{tikzpicture}
\end{itemize}

Here, the conclusion diagram asserts that the overlap area is empty. Since this information is not contained in the premise diagram, the inference is invalid.

We conclude with a special kind of inference:

\begin{align*}
\text{All cell phones are wireless devices.} \\
\text{Therefore, some cell phones are wireless devices.}
\end{align*}

The completed Venn diagrams are as follows:

\begin{itemize}
\item All $C$ are $W$. \\
\begin{tikzpicture}
\draw[fill=red] (0,0) circle (1cm);
\filldraw (0,0) circle (0.2cm);
\draw[fill=red] (-1,0) circle (1cm);
\end{tikzpicture}
\item Some $C$ are $W$. \\
\begin{tikzpicture}
\draw[fill=red] (0,0) circle (1cm);
\filldraw (0,0) circle (0.2cm) node{X};
\draw[fill=red] (-1,0) circle (1cm);
\end{tikzpicture}
\end{itemize}
The information of the conclusion diagram is not contained in the premise diagram, so the inference is invalid. However, if the premise were interpreted as having existential import, then the C circle in the premise diagram would not be empty. Specifically, there would be members in the overlap area. This would make the inference valid.

Arguments of this sort are said to commit the existential fallacy. From the Boolean standpoint, the **existential fallacy** is a formal fallacy that occurs whenever an argument is invalid merely because the premise lacks existential import. Such arguments always have a universal premise and a particular conclusion. The fallacy consists in attempting to derive a conclusion having existential import from a premise that lacks it.

The existential fallacy is easy to detect. Just look for a pair of diagrams in which the premise diagram contains shading and the conclusion diagram contains an X. If the X in the conclusion diagram is in the same part of the left-hand circle that is unshaded in the premise diagram, then the inference commits the existential fallacy. In the example we just considered, the premise diagram contains shading, and the conclusion diagram contains an X. Also, the X in the conclusion diagram is in the overlap area, and this area is unshaded in the premise diagram. Thus, the inference commits the existential fallacy.

There are exactly eight inference forms that commit the existential fallacy. Four of them are as follows. (The other four are left for an exercise.) Among these forms, recall that any proposition asserting that a particular (I or O) proposition is false is a universal proposition, and any proposition asserting that a universal (A or E) proposition is false is a particular proposition. With this in mind, you can see that all of these forms proceed from a universal premise to a particular conclusion.

**Existential fallacy**

\[
\text{All } A \text{ are } B. \\
\text{Therefore, some } A \text{ are } B.
\]

\[
\text{It is false that some } A \text{ are not } B. \\
\text{Therefore, it is false that no } A \text{ are } B.
\]

\[
\text{No } A \text{ are } B. \\
\text{Therefore, it is false that all } A \text{ are } B.
\]

\[
\text{It is false that some } A \text{ are } B. \\
\text{Therefore, some } A \text{ are not } B.
\]

Finally, while all of these forms proceed from a universal premise to a particular conclusion, it is important to see that not every inference having a universal premise and a particular conclusion commits the existential fallacy. For example, the inference “All A are B; therefore, some A are not B” does not commit this fallacy. This inference is invalid because the conclusion contradicts the premise. Thus, to detect the existential fallacy, one must ensure that the invalidity results merely from the fact that the premise lacks existential import. This can easily be done by constructing a Venn diagram.

**Exercise 4.3**

I. Draw Venn diagrams for the following propositions.

1. No life decisions are happenings based solely on logic.

2. All electric motors are machines that depend on magnetism.

3. Some political campaigns are mere attempts to discredit opponents.

4. Some rock music lovers are not fans of Madonna.

5. All redistricting plans are sources of controversy.

6. No tax audits are pleasant experiences for cheaters.

7. Some housing developments are complexes that exclude children.

8. Some cruise ships are not steam-driven vessels.

II. Use the modern square of opposition to determine whether the following immediate inferences are valid or invalid from the Boolean standpoint.
1. No sculptures by Rodin are boring creations. Therefore, all sculptures by Rodin are boring creations.

2. It is false that some lunar craters are volcanic formations.

   Therefore, no lunar craters are volcanic formations.

3. All trial lawyers are people with stressful jobs.

   Therefore, some trial lawyers are people with stressful jobs.

4. All dry martinis are dangerous concoctions.

   Therefore, it is false that some dry martinis are not dangerous concoctions.

5. It is false that no jazz musicians are natives of New Orleans.

   Therefore, some jazz musicians are not natives of New Orleans.

6. Some country doctors are altruistic healers.

   Therefore, some country doctors are not altruistic healers.

7. No fertility drugs are solutions to every problem.

   Therefore, it is false that all fertility drugs are solutions to every problem.

8. It is false that no credit cards are things that contain holograms.

   Therefore, some credit cards are things that contain holograms.

9. It is false that some stunt pilots are not colorful daredevils.

   Therefore, it is false that some stunt pilots are colorful daredevils.

10. No vampires are avid connoisseurs of garlic bread.

    Therefore, it is false that some vampires are avid connoisseurs of garlic bread.

11. No talk radio shows are accurate sources of information.

    Therefore, some talk radio shows are not accurate sources of information.

12. Some stellar constellations are spiral-shaped objects.

    Therefore, no stellar constellations are spiral-shaped objects.

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13. It is false that some soap bubbles are not occasions of glee.

    Therefore, some soap bubbles are occasions of glee.

14. It is false that all weddings are light-hearted celebrations.

    Therefore, some weddings are not light-hearted celebrations.

15. It is false that some chocolate soufflés are desserts containing olives.

    Therefore, it is false that all chocolate soufflés are desserts containing olives.

III. Use Venn diagrams to evaluate the immediate inferences in Part II of this exercise.

   Identify any that commit the existential fallacy.

IV. This section of Chapter 4 identified four forms of the existential fallacy. Use Venn diagrams to identify the other four. In doing so, keep in mind that all forms of this fallacy have a universal premise and a particular conclusion, that “It is false that
some $A$ are $B$” and “It is false that some $A$ are not $B$” are universal propositions, and “It is false that all $A$ are $B$” and “It is false that no $A$ are $B$” are particular.

### 4.4 Conversion, Obversion, and Contraposition

For a preliminary glimpse into the content of this section, consider the statement “No dogs are cats.” This statement claims that the class of dogs is separated from the class of cats. But the statement “No cats are dogs” claims the same thing. Thus, the two statements have the same meaning and the same truth value. For another example, consider the statement “Some dogs are not retrievers.” This statement claims there is at least one dog outside the class of retrievers. But the statement “Some dogs are non-retrievers” claims the same thing, so again, the two statements have the same meaning and the same truth value.

Conversion, obversion, and contraposition are operations that can be performed on a categorical proposition, resulting in a new statement that may or may not have the same meaning and truth value as the original statement. Venn diagrams are used to determine how the two statements relate to each other.

**Conversion**

The simplest of the three operations is conversion, and it consists in switching the subject term with the predicate term. For example, if the statement “No foxes are hedgehogs” is converted, the resulting statement is “No hedgehogs are foxes.” This new statement is called the converse of the given statement. To see how the four types of categorical propositions relate to their converse, compare the following sets of Venn diagrams:

<table>
<thead>
<tr>
<th>Given statement form</th>
<th>Converse</th>
</tr>
</thead>
<tbody>
<tr>
<td>All $A$ are $B$.</td>
<td>All $B$ are $A$.</td>
</tr>
<tr>
<td>No $A$ are $B$.</td>
<td>No $B$ are $A$.</td>
</tr>
<tr>
<td>Some $A$ are $B$.</td>
<td>Some $B$ are $A$.</td>
</tr>
<tr>
<td>Some $A$ are not $B$.</td>
<td>Some $B$ are not $A$.</td>
</tr>
</tbody>
</table>

If we examine the diagram for the E statement, we see that it is identical to that of its converse. Also, the diagram for the I
statement is identical to that of its converse. This means that the E statement and its converse are logically equivalent, and the I statement and its converse are logically equivalent. Two statements are said to be logically equivalent statements when they necessarily have the same truth value (as we will see again in Chapter 6). Thus, converting an E or I statement gives a new statement that always has the same truth value (and the same meaning) as the given statement. These equivalences are strictly proved by the Venn diagrams for the E and I statements.

On the other hand, the diagram for the A statement is clearly not identical to the diagram for its converse, and the diagram for the O statement is not identical to the

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diagram for its converse. Also, these pairs of diagrams are not the exact opposite of each other, as is the case with contradictory statements. This means that an A statement and its converse are logically unrelated as to truth value, and an O statement and its converse are logically unrelated as to truth value. In other words, converting an A or O statement gives a new statement whose truth value is logically undetermined in relation to the given statement. The converse of an A or O statement does have a truth value, of course, but logic alone cannot tell us what it is.

Because conversion yields necessarily determined results for E and I statements, it can be used as the basis for immediate inferences having these types of statements as premises. The following inference forms are valid:

*No A are B.*
Therefore, *no B are A.*

*Some A are B.*
Therefore, *some B are A.*

Since the conclusion of each inference form necessarily has the same truth value as the premise, if the premise is assumed true, it follows necessarily that the conclusion is true. On the other hand, the next two inference forms are invalid. Each commits the fallacy of illicit conversion:

*All A are B.*
Therefore, *all B are A.*

*Some A are not B.*
Therefore, *some B are not A.*

Here are two examples of inferences that commit the fallacy of illicit conversion:

<table>
<thead>
<tr>
<th>Statements</th>
<th>Truth Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All cats are animals.</td>
<td>(True)</td>
</tr>
<tr>
<td>Therefore, all animals are cats.</td>
<td>(False)</td>
</tr>
<tr>
<td>Some animals are not dogs.</td>
<td>(True)</td>
</tr>
<tr>
<td>Therefore, some dogs are not animals.</td>
<td>(False)</td>
</tr>
</tbody>
</table>

**Obversion**

More complicated than conversion, obversion requires two steps: (1) changing the quality (without changing the quantity), and (2) replacing the predicate with its term complement. The first part of this operation was treated in Exercise 4.2. It consists in changing “No S are P” to “All S are P” and vice versa, and changing “Some S are P” to “Some S are not P” and vice versa.

The second step requires understanding the concept of class complement. The complement of a class is the group consisting of everything outside the class. For example, the complement of the class of dogs is the group that includes everything that is not a dog (cats, fish, trees, and so on). The term complement is the word or group of words that denotes the class complement. For terms consisting of a single word, the term complement is usually formed by simply attaching the prefix “non” to the term. Therefore,
the complement of the term “dog” is “non-dog,” the complement of the term “book” is “non-book,” and so on.

The relationship between a term and its complement can be illustrated by a Venn diagram. For example, if a single circle is allowed to represent the class of dogs, then everything outside the circle represents the class of non-dogs:

![Venn diagram of dogs and non-dogs]

We now have everything we need to form the *obverse* of categorical propositions. First we change the quality (without changing the quantity), and then we replace the predicate term with its term complement. For example, if we are given the statement “All horses are animals,” then the obverse is “No horses are non-animals”; and if we are given the statement “Some trees are maples,” then the obverse is “Some trees are not non-maples.” To see how the four types of categorical propositions relate to their obverse, compare the following sets of Venn diagrams:

<table>
<thead>
<tr>
<th>Given statement form</th>
<th>Contrapositive</th>
</tr>
</thead>
<tbody>
<tr>
<td>All $A$ are $B$.</td>
<td>No $A$ are non-$B$.</td>
</tr>
<tr>
<td><img src="image1" alt="Venn diagram" /></td>
<td><img src="image2" alt="Venn diagram" /></td>
</tr>
<tr>
<td>No $A$ are $B$.</td>
<td>All $A$ are non-$B$.</td>
</tr>
<tr>
<td><img src="image3" alt="Venn diagram" /></td>
<td><img src="image4" alt="Venn diagram" /></td>
</tr>
<tr>
<td>Some $A$ are $B$.</td>
<td>Some $B$ are not non-$A$.</td>
</tr>
<tr>
<td><img src="image5" alt="Venn diagram" /></td>
<td><img src="image6" alt="Venn diagram" /></td>
</tr>
<tr>
<td>Some $A$ are not $B$.</td>
<td>Some $B$ are non-$A$.</td>
</tr>
<tr>
<td><img src="image7" alt="Venn diagram" /></td>
<td><img src="image8" alt="Venn diagram" /></td>
</tr>
</tbody>
</table>

To see how the obverse diagrams are drawn, keep in mind that “non-$B$” designates the area outside the $B$ circle. Thus, “No $A$ are $B$” is equivalent to “All $A$ are non-$B$.”
are non-\( B \)" asserts that the area where \( A \) overlaps non-\( B \) is empty. This is represented by shading the left-hand part of the \( A \) circle. "All \( A \) are non-\( B \)" asserts that all members of \( A \) are outside \( B \). This means that no members of \( A \) are inside \( B \), so the area where \( A \) overlaps \( B \) is shaded. "Some \( A \) are not non-\( B \)" asserts that at least one member of \( A \) is outside \( B \). This means that at least one member of \( A \) is inside \( B \), so an X is placed in the area where \( A \) and \( B \) overlap. Finally, "Some \( A \) are non-\( B \)" asserts that at least one member of \( A \) is outside \( B \), so an X is placed in the left-hand part of the \( A \) circle.

If we examine these pairs of diagrams, we see that the diagram for each given statement form is identical to the diagram for its obverse. This means that each of the four types of categorical proposition is logically equivalent to (and has the same meaning as) its obverse. Thus, if we obvert an \( A \) statement that happens to be true, the resulting statement will be true; if we obvert an \( O \) statement that happens to be false, the resulting statement will be false, and so on.

![Obversion Diagram](image)

Obversion

It is easy to see that if a statement is obverted and then obverted again, the resulting statement will be identical to the original statement. For example, the obverse of "All horses are animals" is "No horses are non-animals." To obvert the latter statement we again change the quality ("no" switches to "all") and replace "non-animals" with its term complement. The term complement is produced by simply deleting the prefix "non." Thus, the obverse of the obverse is "All horses are animals."

When a term consists of more than a single word, more ingenuity is required to form its term complement. For example, if we are given the term "animals that are not native to America," it would not be appropriate to form the term complement by writing "non-animals that are not native to America." Clearly it would be better to write "animals native to America." Even though this is technically not the complement of the given term, the procedure is justified if we allow a reduction in the scope of discourse. This can be seen as follows. Technically the term complement of "animals that are not native to America" denotes all kinds of things such as ripe tomatoes, battleships, gold rings, and so on. But if we suppose that we are talking only about animals (that is, we reduce the scope of discourse to animals), then the complement of this term is "animals native to America."

As is the case with conversion, obversion can be used to supply the link between the premise and the conclusion of immediate inferences. The following inference forms are valid:

<table>
<thead>
<tr>
<th>Given statement form</th>
<th>Contrapositive</th>
</tr>
</thead>
<tbody>
<tr>
<td>All ( A ) are ( B ).</td>
<td>Some ( A ) are ( B ).</td>
</tr>
<tr>
<td>Therefore, no ( A ) are non-( B ).</td>
<td>Therefore, some ( A ) are not non-( B ).</td>
</tr>
<tr>
<td>No ( A ) are ( B ).</td>
<td>Some ( A ) are not ( B ).</td>
</tr>
<tr>
<td>Therefore, all ( A ) are non-( B ).</td>
<td>Therefore, some ( A ) are non-( B ).</td>
</tr>
</tbody>
</table>

Because the conclusion of each inference form necessarily has the same truth value as its premise, if the premise is assumed true, it follows necessarily that the conclusion is true.

**Contraposition**

Like obversion, **contraposition** requires two steps: (1) switching the subject and predicate terms and (2) replacing the subject and predicate terms with their term complements. For example, if the statement "All goats are animals" is contraposed, the resulting statement is "All non-animals are non-goats." This new statement is called the contrapositive of the given statement. To see how all four types of categorical propositions relate to their contrapositive, compare the following sets of diagrams:

<table>
<thead>
<tr>
<th>Given statement form</th>
<th>Contrapositive</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;All ( A ) are ( B ).&quot;</td>
<td>&quot;All ( A ) are non-( B ).&quot;</td>
</tr>
<tr>
<td>&quot;Some ( A ) are ( B ).&quot;</td>
<td>&quot;Some ( A ) are non-( B ).&quot;</td>
</tr>
<tr>
<td>&quot;No ( A ) are ( B ).&quot;</td>
<td>&quot;No ( A ) are non-( B ).&quot;</td>
</tr>
<tr>
<td>&quot;Some ( A ) are non-( B ).&quot;</td>
<td>&quot;Some ( A ) are ( B ).&quot;</td>
</tr>
<tr>
<td>All A are B.</td>
<td>All non-B are non-A.</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------------</td>
</tr>
<tr>
<td><img src="image1" alt="Diagram" /></td>
<td><img src="image2" alt="Diagram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No A are B.</th>
<th>No non-B are non-A.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Diagram" /></td>
<td><img src="image4" alt="Diagram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Some A are B.</th>
<th>Some non-B are non-A.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5" alt="Diagram" /></td>
<td><img src="image6" alt="Diagram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Some A are not B.</th>
<th>Some non-B are not non-A.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image7" alt="Diagram" /></td>
<td><img src="image8" alt="Diagram" /></td>
</tr>
</tbody>
</table>

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To see how the first diagram on the right is drawn, remember that “non-A” designates the area outside A. Thus, “All non-B are non-A” asserts that all members of non-B are outside A. This means that no members of non-B are inside A. Thus, we shade the area where non-B overlaps A. “No non-B are non-A” asserts that the area where non-B overlaps non-A is empty. Since non-B is the area outside the B circle and non-A is the area outside the A circle, the place where these two areas overlap is the area outside both circles. Thus, we shade this area. “Some non-B are non-A” asserts that something exists in the area where non-B overlaps non-A. Again, this is the area outside both circles, so we place an X in this area. Finally, “Some non-B are not non-A” asserts that at least one member of non-B is outside non-A. This means that at least one member of non-B is inside A, so we place an X in the area where non-B overlaps A.

Now, inspection of the diagrams for the A and O statements reveals that they are identical to the diagrams of their contrapositive. Thus, the A statement and its contrapositive are logically equivalent (and have the same meaning), and the O statement and its contrapositive are logically equivalent (and have the same meaning). On the other hand, the diagrams of the E and I statements are neither identical to nor the exact opposite of the diagrams of their contrapositives. This means that contraposing an E or I statement gives a new statement whose truth value is logically undetermined in relation to the given statement.
To help remember when conversion and contraposition yield logically equivalent results, note the second and third vowels in the words. Conversion works for E and I propositions, contraposition works for A and O propositions.

As with conversion and obversion, contraposition may provide the link between the premise and the conclusion of an immediate inference. The following inference forms are valid:

\[
\begin{align*}
&\text{All } A \text{ are } B. \\
&\text{Therefore, all non-}B \text{ are non-}A.
\end{align*}
\]

On the other hand, the following inference forms are invalid. Each commits the fallacy of illicit contraposition:

\[
\begin{align*}
&\text{Some } A \text{ are not } B. \\
&\text{Therefore, some non-}B \text{ are not non-}A.
\end{align*}
\]

\[
\begin{align*}
&\text{No } A \text{ are } B. \\
&\text{Therefore, no non-}B \text{ are non-}A.
\end{align*}
\]

Here are two examples of inferences that commit the fallacy of illicit contraposition:

<table>
<thead>
<tr>
<th>Given statement</th>
<th>Converse</th>
<th>Truth value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No dogs are cats.</td>
<td>Therefore, no non-cats are non-dogs.</td>
<td>(False)</td>
</tr>
<tr>
<td>Some animals are non-cats.</td>
<td>Therefore, some cats are non-animals.</td>
<td>(False)</td>
</tr>
</tbody>
</table>

In regard to the first inference, an example of something that is both a non-cat and a non-dog is a pig. Thus, the conclusion implies that no pigs are pigs, which is false. In regard to the second inference, if both premise and conclusion are obverted, the premise becomes “Some animals are not cats,” which is true, and the conclusion becomes “Some cats are not animals,” which is false.

Both illicit conversion and illicit contraposition are formal fallacies: They can be detected through mere examination of the form of an argument.

Finally, note that the Boolean interpretation of categorical propositions has prevailed throughout this section. This means that the results obtained are unconditional, and they hold true regardless of whether the terms in the propositions denote actually existing things. Thus, they hold for propositions about unicorns and leprechauns just as they do for propositions about dogs and animals. These results are summarized in the following table.

<table>
<thead>
<tr>
<th>Given statement</th>
<th>Converse</th>
<th>Truth value</th>
</tr>
</thead>
<tbody>
<tr>
<td>E: No A are B.</td>
<td>No B are A.</td>
<td>Same truth value as given statement</td>
</tr>
<tr>
<td>I: Some A are B.</td>
<td>Some B are A.</td>
<td></td>
</tr>
<tr>
<td>A: All A are B.</td>
<td>All B are A.</td>
<td></td>
</tr>
<tr>
<td>O: Some A are not B.</td>
<td>Some B are not A.</td>
<td>Undetermined truth value</td>
</tr>
</tbody>
</table>

CONVERSION: SWITCH SUBJECT AND PREDICATE TERMS.
I. Exercises 1 through 6 provide a statement, its truth value in parentheses, and an operation to be performed on that statement. Supply the new statement and the truth value of the new statement. Exercises 7 through 12 provide a statement, its truth value in parentheses, and a new statement. Determine how the new statement was derived from the given statement and supply the truth value of the new statement.

<table>
<thead>
<tr>
<th>Given statement</th>
<th>Operation</th>
<th>New statement</th>
<th>Truth value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: All A are B.</td>
<td>conv.</td>
<td>No A are non-B.</td>
<td>Same truth value as given statement</td>
</tr>
<tr>
<td>E: No A are B.</td>
<td></td>
<td>All A are non-B.</td>
<td></td>
</tr>
<tr>
<td>I: Some A are B.</td>
<td></td>
<td>Some A are not non-B.</td>
<td></td>
</tr>
<tr>
<td>O: Some A are not B.</td>
<td></td>
<td>Some A are non-B.</td>
<td></td>
</tr>
</tbody>
</table>

II. Perform the operations of conversion, obversion, and contraposition as indicated.

1. Convert the following propositions and state whether the converse is logically equivalent or not logically equivalent to the given proposition.

- All hurricanes are storms intensified by global warming.

http://vrle.galegroup.com/vrle/printdoc.do?sgHitCountType=None&sort=&prodId=VRL&userGroupName=857b3a2d26eb02cf%3A1dd45f19%3A14067cd6...
b. No sex-change operations are completely successful procedures.

c. Some murals by Diego Rivera are works that celebrate the revolutionary spirit.

d. Some forms of carbon are not substances with a crystalline structure.

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2. Obvert the following propositions and state whether the obverse is logically equivalent or not logically equivalent to the given proposition.

a. All radically egalitarian societies are societies that do not preserve individual liberties.

b. No cult leaders are people who fail to brainwash their followers.

c. Some college football coaches are people who do not slip money to their players.

d. Some budgetary cutbacks are not actions fair to the poor.

3. Contrapose the following propositions and state whether the contrapositive is logically equivalent or not logically equivalent to the given proposition.

a. All physicians whose licenses have been revoked are physicians ineligible to practice.

b. No unpersecuted migrants are migrants granted asylum.

c. Some politicians who do not defend Social Security are politicians who do not want to increase taxes.

d. Some opponents of gay marriage are not opponents of civil unions.

III. Use conversion, obversion, and contraposition to determine whether the following arguments are valid or invalid. For those that are invalid, name the fallacy committed.

1. All commodity traders are gamblers who risk sudden disaster.

Therefore, all gamblers who risk sudden disaster are commodity traders.

2. No child abusers are people who belong in day-care centers.

Therefore, all child abusers are people who do not belong in day-care centers.

3. Some states having limited powers are not slave states.

Therefore, some free states are not states having unlimited powers.

4. Some insane people are illogical people.

Therefore, some logical people are sane people.

5. Some organ transplants are not sensible operations.

Therefore, some organ transplants are senseless operations.

6. No individuals who laugh all the time are people with a true sense of humor.

Therefore, no people with a true sense of humor are individuals who laugh all the time.

7. All periods when interest rates are high are times when businesses tend not to expand.

Therefore, all times when businesses tend to expand are periods when interest rates are low.

8. Some swimsuits are not garments intended for the water.

Therefore, some garments intended for the water are not swimsuits.
9. No promises made under duress are enforceable contracts. 

Therefore, no unenforceable contracts are promises made in the absence of duress.

10. All ladies of the night are individuals with low self-esteem. 

Therefore, no ladies of the night are individuals with high self-esteem.

11. Some graffiti writers are artists relieving pent-up frustrations. 

Therefore, some artists relieving pent-up frustrations are graffiti writers.

12. Some peaceful revolutions are episodes that erupt in violence. 

Therefore, some episodes that do not erupt in violence are non-peaceful revolutions.

13. Some insurance companies are not humanitarian organizations. 

Therefore, some humanitarian organizations are not insurance companies.

14. Some fossil fuels are unrenewable energy sources. 

Therefore, some fossil fuels are not renewable energy sources.

15. All hired killers are criminals who deserve the death penalty. 

Therefore, all criminals who deserve the death penalty are hired killers.

16. No nonprescription drugs are medicines without adverse effects. 

Therefore, no medicines with adverse effects are prescription drugs.

17. All fire-breathing dragons are lizards that languish in soggy climates. 

Therefore, no fire-breathing dragons are lizards that flourish in soggy climates.

18. Some distant galaxies are not structures visible to the naked eye. 

Therefore, some structures visible to the naked eye are not distant galaxies.

19. All unpleasant experiences are things we do not like to remember. 

Therefore, all things we like to remember are pleasant experiences.

20. Some pro-lifers are not people concerned with child welfare. 

Therefore, some pro-lifers are people unconcerned with child welfare.

4.5 The Traditional Square of Opposition

In Section 4.3 we adopted the Boolean standpoint, and we saw how the modern square of opposition applies regardless of whether the propositions refer to actually existing things. In this section, we adopt the Aristotelian standpoint, which recognizes that universal propositions about existing things have existential import. For such propositions the traditional square of opposition becomes applicable. Like the modern square, the traditional square of opposition is an arrangement of lines that illustrates logically necessary relations among the four kinds of categorical propositions. However, because the Aristotelian standpoint recognizes the additional factor of existential import, the traditional square supports more inferences than does the modern square. It is represented as follows:
The four relations in the traditional square of opposition may be characterized as follows:

- **Contradictory** = opposite truth value
- **Contrary** = at least one is false (not both true)
- **Subcontrary** = at least one is true (not both false)
- **Subalternation** = truth flows downward, falsity flows upward

The **contradictory relation** is the same as that found in the modern square. Thus, if a certain **A** proposition is given as true, the corresponding **O** proposition is false, and vice versa; and if a certain **A** proposition is given as false, the corresponding **O** proposition is true, and vice versa. The same relation holds between the **E** and **I** propositions. The contradictory relation thus expresses complete opposition between propositions.

The **contrary relation** differs from the contradictory in that it expresses only partial opposition. Thus, if a certain **A** proposition is given as true, the corresponding **E** proposition is false (because at least one must be false), and if an **E** proposition is given as true, the corresponding **A** proposition is false. But if an **A** proposition is given as false, the corresponding **E** proposition could be either true or false without violating the “at least one is false” rule. In this case, the **E** proposition has logically undetermined truth value. Similarly, if an **E** proposition is given as false, the corresponding **A** proposition has logically undetermined truth value.

These results are borne out in ordinary language. Thus, if we are given the actually true **A** proposition “All cats are animals,” the corresponding **E** proposition “No cats are animals” is false, and if we are given the actually true **E** proposition “No cats are dogs,” the corresponding **A** proposition “All cats are dogs” is false. Thus, the **A** and **E** propositions cannot both be true. However, they can both be false. “All animals are cats” and “No animals are cats” are both false.

The **subcontrary relation** also expresses a kind of partial opposition. If a certain **I** proposition is given as false, the corresponding **O** proposition is true (because at least one must be true), and if an **O** proposition is given as false, the corresponding **I** proposition is true. But if either an **I** or an **O** proposition is given as true, then the corresponding proposition could be either true or false without violating the “at least one is true” rule. Thus, in this case the corresponding proposition would have logically undetermined truth value.

The subalternation relation is represented by two arrows: a downward arrow marked with the letter **T** (true), and an upward arrow marked with an **F** (false). These arrows can be thought of as pipelines through which truth values “flow.” The downward arrow “transmits” only truth, and the upward arrow only falsity. Thus, if an **A** proposition is given as true, the corresponding **I** proposition is true also, and if an **I** proposition is given as false, the corresponding **A** proposition is false. But if an **A** proposition is given as false, this truth value cannot be transmitted downward, so the corresponding **I** proposition will have logically undetermined truth value. Conversely, if an **I** proposition is given as true, this truth value cannot be transmitted upward, so the corresponding **A** proposition will have logically undetermined truth value. Analogous reasoning prevails for the subalternation relation between the **E** and **O** propositions. To remember the direction of the arrows for subalternation, imagine that truth descends from “above,” and falsity rises up from “below.”
Now that we have examined these four relations individually, let us see how they can be used together to determine the truth values of corresponding propositions. The first rule of thumb that we should keep in mind when using the square to compute more than one truth value is always to use contradiction first. Now, let us suppose that we are told that the nonsensical proposition “All adlers are bobkins” is true. Suppose further that adlers actually exist, so we are justified in using the traditional square of opposition. By the contradictory relation, “Some adlers are not bobkins” is false. Then, by either the contrary or the subalternation relation, “No adlers are bobkins” is false. Finally, by either contradictory, subalternation, or subcontrary, “Some adlers are bobkins” is true.

Next, let us see what happens if we assume that “All adlers are bobkins” is false. By the contradictory relation, “Some adlers are not bobkins” is true, but nothing more can be determined. In other words, given a false A proposition, both contrary and subalternation yield undetermined results, and given a true O proposition (the one whose truth value we just determined), subcontrary and subalternation yield undetermined results. Thus, the corresponding E and I propositions have logically undetermined truth value. This result illustrates two more rules of thumb. Assuming that we always use the contradictory relation first, if one of the remaining relations yields a logically undetermined truth value, the others will as well. The other rule is that whenever one statement turns out to have logically undetermined truth value, its contradictory will also. Thus, statements having logically undetermined truth value will always occur in pairs, at opposite ends of diagonals on the square.

Testing Immediate Inferences

Next, let us see how we can use the traditional square of opposition to test immediate inferences for validity. Here is an example:

All Swiss watches are true works of art.
Therefore, it is false that no Swiss watches are true works of art.

We begin, as usual, by assuming the premise is true. Since the premise is an A proposition, by the contrary relation the corresponding E proposition is false. But this is exactly what the conclusion says, so the argument is valid.

Here is another example:

Some viruses are structures that attack T cells.
Therefore, some viruses are not structures that attack T cells.

Here the premise and conclusion are linked by the subcontrary relation. According to that relation, if the premise is assumed true, the conclusion has logically undetermined truth value, and so the inference is invalid. It commits the formal fallacy of illicit subcontrary. Analogously, inferences that depend on an incorrect application of the contrary relation commit the formal fallacy of illicit contrary and inferences that depend on an illicit application of subalternation commit the formal fallacy of illicit subalternation. Some forms of these fallacies are as follows:

Illicit contrary

It is false that all A are B.
Therefore, no A are B.

It is false that no A are B.
Therefore, all A are B.

Illicit subcontrary

Some A are B.
Therefore, it is false that some A are not B.

Some A are not B.
Therefore, some A are B.

Illicit subalternation

Some A are not B.
Therefore, no A are B.

It is false that all A are B.
Therefore, it is false that some A are B.

Cases of the incorrect application of the contradictory relation are so infrequent that an “illicit contradictory” fallacy is not
usually recognized.

As we saw at the beginning of this section, for the traditional square of opposition to apply, the Aristotelian standpoint must be adopted, and the propositions to which it is applied must assert something about actually existing things. The question may now be asked, What happens when the Aristotelian standpoint is adopted but the propositions are about things that do not exist? The answer is that under these conditions the traditional square gives exactly the same results as the modern square (see Section 4.3). Inferences that are based on a correct application of the contradictory relation are valid, but inferences that are based on an otherwise correct application of the other three relations are invalid and commit the existential fallacy.

The reason for this result is easy to see. The modern square of opposition rests on the Boolean standpoint, and the traditional square rests on the Aristotelian standpoint. But the Aristotelian standpoint differs from the Boolean only with respect to universal propositions about existing things. The Aristotelian standpoint recognizes these propositions as having existential import, while the Boolean standpoint does not. But universal propositions about things that do not exist have no existential import from the Aristotelian standpoint. In other words, the Aristotelian standpoint interprets these propositions in exactly the same way as does the Boolean. Thus, for universal propositions about things that do not exist, the traditional square gives exactly the same results as the modern square.

Accordingly, the existential fallacy is committed from the Aristotelian standpoint when and only when contrary, subcontrary, and subalternation are used (in an otherwise correct way) to draw a conclusion from a premise about things that do not exist. All such inferences begin with a universal proposition, which has no existential import, and they conclude with a particular proposition, which has existential import. The existential fallacy is never committed in connection with the contradictory relation, nor is it committed in connection with conversion, obversion, or contraposition, all of which hold regardless of existence. The following inferences commit the existential fallacy from the Aristotelian standpoint:

All witches who fly on broomsticks are fearless women.
Therefore, some witches who fly on broomsticks are fearless women.

No wizards with magical powers are malevolent beings.
Therefore, it is false that all wizards with magical powers are malevolent beings.

The first depends on an otherwise correct use of the subalternation relation, and the second on an otherwise correct use of the contrary relation. If flying witches and magical wizards actually existed, both arguments would be valid. But since they do not exist, both arguments are invalid and commit the existential fallacy. In regard to

Existential fallacy examples—Two standpoints

<table>
<thead>
<tr>
<th>All cats are animals.</th>
<th>Some cats are animals.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boolean: Invalid, existential fallacy</td>
<td>Aristotelian: Valid</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>All unicorns are animals.</th>
<th>Some unicorns are animals.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boolean: Invalid, existential fallacy</td>
<td>Aristotelian: Invalid, existential fallacy</td>
</tr>
</tbody>
</table>

the second example, recall that the conclusion, which asserts that an A proposition is false, is actually a particular proposition. Thus, this example, like the first one, proceeds from the universal to the particular.

The phrase conditionally valid applies to an argument after the Aristotelian standpoint has been adopted and we are not certain if the subject term of the premise denotes actually existing things. For example, the following inference is conditionally valid:

All students who failed the exam are students on probation.
Therefore, some students who failed the exam are students on probation.

The validity of this inference rests on whether there were in fact any students who failed the exam. The inference is either valid
or invalid, but we lack sufficient information about the meaning of the premise to tell which is the case. Once it becomes
known that there are indeed some students who failed the exam, we can assert that the inference is valid from the Aristotelian
standpoint. But if there are no students who failed the exam, the inference is invalid because it commits the existential fallacy.

Similarly, all inference forms that depend on valid applications of contrary, subcontrary, and subalternation are conditionally
valid because we do not know if the letters in the propositions denote actually existing things. For example, the following
inference form, which depends on the contrary relation, is conditionally valid:

All A are B.
Therefore, it is false that no A are B.

If “dogs” and “animals” are substituted in place of A and B, respectively, the resulting inference is valid. But if “unicorns” and
“animals” are substituted, the resulting inference is invalid because it commits the existential fallacy. In Section 4.3, we noted
that all inferences (and inference forms) that are valid from the Boolean standpoint are unconditionally valid. They are valid
regardless of whether their terms denote actually existing things.

In testing an inference for validity, we are never concerned with the actual truth of the premise. Regardless of whether the
premise is actually true or false, we always begin by assuming it to be true, and then we determine how this assumption bears
on the truth or falsity of the conclusion. The actual truth of the premise affects only the soundness of the argument. So let us
now turn to the question of soundness. Recall from Section 1.4 that a sound argument is one that is valid and has all true
premises, and consider the following example:

All cats are dogs.
Therefore, some cats are dogs.

The premise is obviously false; but if we assume it to be true, then it follows necessarily by subalternation that the conclusion
is true. Thus, the inference is valid. However, because the premise is false, the inference is unsound.

Here is another example:

No rabbits are toads.
Therefore, it is false that all rabbits are toads.

This inference is sound. By the contrary relation it is valid, and it also has a true premise.

Here is a final example:

Some unicorns are not gazelles.
Therefore, it is false that all unicorns are gazelles.

This inference differs from the others in that the premise asserts the existence of something that does not actually exist
(namely, unicorns). In other words, the premise seems to be self-contradictory. Nevertheless, the inference can be evaluated in
the usual way. If the premise is assumed true, then it necessarily follows that the conclusion is true by the contradictory
relation. Thus, the inference is valid. But the inference is unsound because it has a false premise. The premise asserts the
existence of something that does not actually exist.

Now that we have seen how the traditional square of opposition, by itself, is used to test inferences for validity and soundness,
let us see how it can be used together with the operations of conversion, obversion, and contraposition to prove the validity of
inferences that are given as valid. Suppose we are given the following valid inference:

All inappropriate remarks are faux pas.
Therefore, some faux pas are not appropriate remarks.

To prove this inference valid, we select letters to represent the terms, and then we use some combination of conversion,
obversion, and contraposition together with the traditional square to find the intermediate links between premise and

<table>
<thead>
<tr>
<th>All non-(A) are (F).</th>
<th>(assumed true)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some non-(A) are (F).</td>
<td>(true by subalternation)</td>
</tr>
<tr>
<td>Some (F) are non-(A).</td>
<td>(true by conversion)</td>
</tr>
<tr>
<td>Therefore, some (F) are not (A).</td>
<td>(true by obversion)</td>
</tr>
</tbody>
</table>
The premise is the first line in this proof, and each succeeding step is validly derived from the one preceding it by the relation written in parentheses at the right. Since the conclusion (which is the last step) follows by a series of three necessary inferences, the inference is valid.

Various strategies can be used to construct proofs such as this, but one useful procedure is first to concentrate on obtaining the individual terms as they appear in the conclusion, then to attend to the order of the terms, and finally to use the square of opposition to adjust quality and quantity. As the example proof illustrates, however, variations on this procedure are sometimes necessary. The fact that the predicate of the conclusion is “A,” while “non-A” appears in the premise, leads us to think of obversion. But using obversion to change “non-A” into “A” requires that the “non-A” in the premise be moved into the predicate position via conversion. The latter operation, however, is valid only on E and I statements, and the premise is an A statement. The fact that the conclusion is a particular statement suggests subalternation as an intermediate step, thus yielding an I statement that can be converted.

Exercise 4.5

I. Use the traditional square of opposition to find the answers to these problems. When a statement is given as false, simply enter an “F” into the square of opposition and compute (if possible) the other truth values.

1. If “All fashion fads are products of commercial brainwashing” is true, what is the truth value of the following statements?
   a. No fashion fads are products of commercial brainwashing.
   b. Some fashion fads are products of commercial brainwashing.
   c. Some fashion fads are not products of commercial brainwashing.

2. If “All fashion fads are products of commercial brainwashing” is false, what is the truth value of the following statements?
   a. No fashion fads are products of commercial brainwashing.
   b. Some fashion fads are products of commercial brainwashing.
   c. Some fashion fads are not products of commercial brainwashing.

3. If “No sting operations are cases of entrapment” is true, what is the truth value of the following statements?
   a. All sting operations are cases of entrapment.
   b. Some sting operations are cases of entrapment.
   c. Some sting operations are not cases of entrapment.

4. If “No sting operations are cases of entrapment” is false, what is the truth value of the following statements?
   a. All sting operations are cases of entrapment.
   b. Some sting operations are cases of entrapment.
   c. Some sting operations are not cases of entrapment.

5. If “Some assassinations are morally justifiable actions” is true, what is the truth value of the following statements?
   a. All assassinations are morally justifiable actions.
   b. No assassinations are morally justifiable actions.
   c. Some assassinations are not morally justifiable actions.

6. If “Some assassinations are morally justifiable actions” is false, what is the truth value of the following statements?
   a. All assassinations are morally justifiable actions.
b. No assassinations are morally justifiable actions.

c. Some assassinations are not morally justifiable actions.

7. If “Some obsessive-compulsive behaviors are not curable diseases” is true, what is the truth value of the following statements?

a. All obsessive-compulsive behaviors are curable diseases.

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b. No obsessive-compulsive behaviors are curable diseases.

c. Some obsessive-compulsive behaviors are curable diseases.

8. If “Some obsessive-compulsive behaviors are not curable diseases” is false, what is the truth value of the following statements?

a. All obsessive-compulsive behaviors are curable diseases.

b. No obsessive-compulsive behaviors are curable diseases.

c. Some obsessive-compulsive behaviors are curable diseases.

II. Use the traditional square of opposition to determine whether the following immediate inferences are valid or invalid. Name any fallacies that are committed.

1. All advocates of school prayer are individuals who insist on imposing their views on others.

Therefore, some advocates of school prayer are individuals who insist on imposing their views on others.

2. It is false that no jailhouse informants are people who can be trusted.

Therefore, some jailhouse informants are not people who can be trusted.

3. All homemakers are people with real jobs.

Therefore, it is false that no homemakers are people with real jobs.

4. It is false that some trolls are not creatures who live under bridges.

Therefore, it is false that no trolls are creatures who live under bridges.

5. Some campus romances are episodes plagued by violence.

Therefore, some campus romances are not episodes plagued by violence.

6. Some pornographic publications are materials protected by the First Amendment.

Therefore, it is false that no pornographic publications are materials protected by the First Amendment.

7. It is false that all mainstream conservatives are people who support free legal services for the poor.

Therefore, no mainstream conservatives are people who support free legal services for the poor.

8. It is false that some forms of human creativity are activities amenable to mathematical analysis.

Therefore, it is false that all forms of human creativity are activities amenable to mathematical analysis.

9. It is false that some tooth fairies are daytime visitors.

Therefore, some tooth fairies are not daytime visitors.

10. It is false that some orthodox psychoanalysts are not individuals driven by a religious fervor.
Therefore, it is false that some orthodox psychoanalysts are individuals driven by a religious fervor.

11. Some school busses manufactured on the moon are not plasma-powered vehicles.

Therefore, it is false that all school busses manufactured on the moon are plasma-powered vehicles.

12. It is false that some network news programs are exercises in mediocrity.

Therefore, it is false that no network news programs are exercises in mediocrity.

13. No flying reindeer are animals who get lost in the fog.

Therefore, it is false that all flying reindeer are animals who get lost in the fog.

14. It is false that no leveraged buyouts are deals unfair to workers.

Therefore, all leveraged buyouts are deals unfair to workers.

15. It is false that some wood ticks are not carriers of Lyme disease.

Therefore, some wood ticks are carriers of Lyme disease.

III. Use the traditional square of opposition to determine whether the following immediate inferences are valid or invalid and sound or unsound. Name any fallacies that are committed.

1. All dolphins are polar bears.

Therefore, it is false that no dolphins are polar bears.

2. It is false that some recessions are not periods of economic decline.

Therefore, it is false that no recessions are periods of economic decline.

3. It is false that some suicide survivors are comeback kids.

Therefore, some suicide survivors are not comeback kids.

4. It is false that some ruby earrings are not pieces of jewelry.

Therefore, some ruby earrings are pieces of jewelry.

5. It is false that all visitors to Rio are carnival addicts.

Therefore, no visitors to Rio are carnival addicts.

6. Some tax cheats are not honest citizens.

Therefore, no tax cheats are honest citizens.

7. All truthful lies are curious assertions.

Therefore, some truthful lies are curious assertions.

8. It is false that no bankrupt hair salons are thriving enterprises.

Therefore, all bankrupt hair salons are thriving enterprises.

9. It false that some functional skateboards are not devices equipped with wheels.

Therefore, all functional skateboards are devices equipped with wheels.

10. Some film directors are artistic visionaries.

Therefore, some film directors are not artistic visionaries.
IV. Exercises 1 through 10 provide a statement, its truth value in parentheses, and an operation to be performed on that statement. Supply the new statement and the truth value of the new statement. Exercises 11 through 20 provide a statement, its truth value in parentheses, and a new statement. Determine how the new statement was derived from the given statement and supply the truth value of the new statement. Take the Aristotelian standpoint in working these exercises and assume that the terms refer to actually existing things.

<table>
<thead>
<tr>
<th>Given statement</th>
<th>Operation/relation</th>
<th>New statement</th>
<th>Truth value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. All non-(A) are (B). (T)</td>
<td>contrap.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Some (A) are non-(B). (F)</td>
<td>subalt.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. No (A) are non-(B). (T)</td>
<td>obv.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Some non-(A) are not (B). (T)</td>
<td>subcon.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. No (A) are non-(B). (F)</td>
<td>contradic.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. No (A) are (B). (T)</td>
<td>contrap.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. All non-(A) are (B). (T)</td>
<td>contrary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Some (A) are not non-(B). (F)</td>
<td>obv.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. No (A) are non-(B). (F)</td>
<td>conv.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Some non-(A) are non-(B). (F)</td>
<td>subcon.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Some non-(A) are not (B). (T)</td>
<td></td>
<td>All non-(A) are (B).</td>
<td></td>
</tr>
<tr>
<td>12. Some (A) are non-(B). (T)</td>
<td></td>
<td>Some non-(B) are (A).</td>
<td></td>
</tr>
<tr>
<td>13. All non-(A) are (B). (F)</td>
<td></td>
<td>No non-(A) are non-(B).</td>
<td></td>
</tr>
<tr>
<td>14. Some non-(A) are not (B). (T)</td>
<td></td>
<td>No non-(A) are (B).</td>
<td></td>
</tr>
<tr>
<td>15. All (A) are non-(B). (F)</td>
<td></td>
<td>All non-(B) are (A).</td>
<td></td>
</tr>
<tr>
<td>16. Some non-(A) are non-(B). (F)</td>
<td></td>
<td>No non-(A) are non-(B).</td>
<td></td>
</tr>
<tr>
<td>17. Some (A) are not non-(B). (T)</td>
<td></td>
<td>Some (B) are not non-(A).</td>
<td></td>
</tr>
<tr>
<td>18. No non-(A) are (B). (T)</td>
<td></td>
<td>Some non-(A) are not (B).</td>
<td></td>
</tr>
<tr>
<td>19. No (A) are non-(B). (F)</td>
<td></td>
<td>All (A) are non-(B).</td>
<td></td>
</tr>
<tr>
<td>20. Some non-(A) are (B). (F)</td>
<td></td>
<td>Some non-(A) are not (B).</td>
<td></td>
</tr>
</tbody>
</table>

V. Use either the traditional square of opposition or conversion, obversion, or contraposition to determine whether the following immediate inferences are valid or invalid. For those that are invalid, name the fallacy committed.

1. It is false that some jogging events are not aerobic activities.
   Therefore, it is false that no jogging events are aerobic activities.

2. No meat-eating vegetarians are individuals with a high-protein diet.
   Therefore, no individuals with a high-protein diet are meat-eating vegetarians.

3. Some jobs in health care are not glamorous occupations.
   Therefore, some jobs in health care are glamorous occupations.

4. Some terminally ill patients are patients who do not want to live.
   Therefore, some patients who want to live are recovering patients.

5. All Barbie dolls are toys that engender a false sense of values.
   Therefore, no Barbie dolls are toys that engender a true sense of values.

6. All flying elephants are jolly pachyderms.
Therefore, some flying elephants are jolly pachyderms.

7. It is false that some international terrorists are political moderates.

Therefore, some international terrorists are not political moderates.

8. No pet hamsters are animals that need much attention.
Therefore, it is false that all pet hamsters are animals that need much attention.

9. Some hedge-fund managers are not responsible investors.
Therefore, some responsible investors are not hedge-fund managers.

10. It is false that all substances that control cell growth are hormones.
Therefore, no substances that control cell growth are hormones.

11. Some cases of whistle-blowing are actions disloyal to employers.
Therefore, some cases of whistle-blowing are not actions loyal to employers.

12. No stolen computer chips are easy items to trace.
Therefore, no difficult items to trace are computer chips that are not stolen.

13. Some economists are followers of Ayn Rand.
Therefore, some economists are not followers of Ayn Rand.

14. All porcelain figurines are fragile artifacts.
Therefore, it is false that some porcelain figurines are not fragile artifacts.

15. Some pleasant recollections are not missed opportunities.
Therefore, some availed opportunities are not unpleasant recollections.

VI. Use the traditional square of opposition together with conversion, obversion, and contraposition to prove that the following immediate inferences are valid. Show each intermediate step in the deduction.

1. All insurance policies are cryptically written documents.
Therefore, some cryptically written documents are insurance policies.

2. No gemstones that do not contain chromium are emeralds.
Therefore, some stones that are not emeralds are not gemstones that contain chromium.

3. It is false that some Ficus benjamineas are untemperamental house plants.
Therefore, all Ficus benjamineas are temperamental house plants.

4. All exogenous morphines are addictive substances.
Therefore, it is false that all addictive substances are endogenous morphines.

5. No people who do not advocate free-enterprise economics are fundamentalist Christians.
Therefore, it is false that some fundamentalist Christians are not people who advocate free-enterprise economics.

6. It is false that some Gothic cathedrals are buildings that do not feature pointed arches.
Therefore, some buildings that feature pointed arches are Gothic cathedrals.
7. Some people who recognize paranormal events are not non-scientists.

Therefore, it is false that no scientists are people who recognize paranormal events.

8. It is false that no unhealthy things to ingest are food additives.

Therefore, some food additives are not healthy things to ingest.

9. It is false that some illegal searches are not sobriety checkpoints. Therefore, some sobriety checkpoints are not legal searches.

10. It is false that some feminists are not advocates of equal pay for equal work. Therefore, it is false that all advocates of equal pay for equal work are non-feminists.

4.6 Venn Diagrams and the Traditional Standpoint

Earlier in this chapter we saw how Venn diagrams can be used to represent the content of categorical propositions from the Boolean standpoint. With a slight modification they can also be used to represent the content of categorical propositions from the traditional, or Aristotelian, standpoint. These modified Venn diagrams can then be used to prove the relationships of the traditional square of opposition, and also to test the validity of immediate inferences from the traditional standpoint.

The difference between the Boolean standpoint and the Aristotelian standpoint concerns only universal (A and E) propositions. From the Boolean standpoint, universal propositions have no existential import, but from the Aristotelian standpoint they do have existential import when their subject terms refer to actually existing things. For example, from the Boolean standpoint the statement “All raccoons are pests” does not imply the existence of anything, but from the Aristotelian standpoint it implies the existence of raccoons. Thus, if we are to construct a Venn diagram to represent such a statement from the Aristotelian standpoint, we need to use some symbol that represents this implication of existence.

The symbol that we will use for this purpose is an X surrounded by a circle. Like the X’s that we have used up until now, this circled X signifies that something exists in the area in which it is placed. However, the two symbols differ in that the uncircled X represents the positive claim of existence made by particular (I and O) propositions, whereas the circled X represents an implication of existence made by universal propositions about actually existing things. For the purpose at hand, a circled X is placed inside the S circle as follows:

In the diagram for the A statement, the left-hand part of the S circle is shaded, so if there are any members of S, they must be in the area where the two circles overlap. Thus, a circled X is placed in the overlap area. In the diagram for the E statement, the overlap area is shaded, so if there are any members of S they must be in the left-hand part of the S circle. Thus, a circled X is placed in this area.
The diagrams for the I and O statements are the same from the Aristotelian standpoint as they are from the Boolean:

<table>
<thead>
<tr>
<th>I: Some S are P.</th>
<th>O: Some S are not P.</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram" /></td>
<td><img src="image2" alt="Diagram" /></td>
</tr>
</tbody>
</table>

Proving the Traditional Square of Opposition

We can now use this modified Venn diagram technique to prove the relations of the traditional square of opposition. Having such a proof is important because up until now these relations have only been illustrated with various examples; they have not been proved. The accompanying figure reproduces the traditional square of opposition together with Venn diagrams that represent the Aristotelian interpretation of the four standard-form propositions.

Let us begin with the contradictory relation. If the A statement is given as true, then the left-hand part of the S circle is empty. This makes the O statement false, because it claims that the left-hand part of the S circle is not empty. And if the O statement is given as true, then the left-hand part of the S circle is not empty, which makes the A statement false. On the other hand, if the O statement is given as false, then the left-hand part of the S circle is empty. However, given that some members of S exist, they must be in the overlap area. This double outcome makes the A statement true. Also, if the A statement is given as false, then either the left-hand part of the S circle is not empty, or the overlap area is empty (or both). If the left-hand part of the S circle is not empty, then the O statement is true. Alternately, if the overlap area is empty, then, given that some members of S exist, they must be in the left-hand part of the S circle, and, once again, the O statement is true. Analogous reasoning applies for the relation between the E and I statements.

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Next, we turn to the contrary relation. If the A statement is given as true, then the overlap area is not empty, which makes the E statement false. By analogous reasoning, if the E statement is given as true, the overlap area is empty, which makes the A statement false. However, if the A statement is given as false (making the O statement true), then the E statement could be either true or false depending on whether or not the overlap area is empty. Thus, in this case the E statement would have logically undetermined truth value. By analogous reasoning, if the E statement is given as false (making the I statement true), the A statement could be either true or false depending on whether or not the left-hand part of the S circle is empty. Thus, the A statement would have logically undetermined truth value.

Turning next to the subcontrary relation, if the I statement is given as false, then the area where the S and P circles overlap is empty. Given that at least one S exists, there must be something in the left-hand part of the S circle, which makes the O statement true. By analogous reasoning, if the O statement is given as false, there must be something in the overlap area, making the I statement true. But if the I statement is given as true, then the O statement could be either true or false depending on whether something exists in the left-hand part of the S circle. Thus, the O statement would have undetermined truth value. Similarly, if the O statement is given as true, then the I statement could be either true or false depending on whether something exists in the overlap area. Thus, the I statement would have undetermined truth value.

Finally, we consider subalternation. If the A statement is given as true, then something exists in the area where the S and P circles overlap, which makes the I statement true as well. And if the I statement is given as false, then the overlap area is empty, making the A statement false. But if the A statement is given as false (making the O statement true), then the I statement could be either true or false depending on whether something exists in the overlap area. Thus, the I statement would have logically undetermined truth value. And if the I statement is given as true, then the A statement could be either true or false depending on whether or not the left-hand part of the S circle is empty. Thus, the A statement would have logically undetermined truth value. Analogous reasoning applies for the subalternation relation between the E and O statements.

**Testing Immediate Inferences**

From the Aristotelian standpoint, the modified Venn diagram technique involving circled X's can be used to test immediate inferences. The only requirement is that the subject and predicate terms of the conclusion be the same as those of the premise. Such inferences depend on the square of opposition and do not involve the operations of conversion, obversion, and contraposition. Venn diagrams can also be used to test inferences involving these latter operations, but a further modification
must be introduced.

Since any inference that is valid from the Boolean standpoint is also valid from the Aristotelian standpoint, testing the inference from the Boolean standpoint is often simpler. If the inference is valid, then it is valid from both standpoints. But if the inference is invalid from the Boolean standpoint and has a particular conclusion, then it may be useful to test it from the Aristotelian standpoint. Let us begin by testing an inference form for validity:

\[
\text{All } A \text{ are } B. \\
\text{Therefore, some } A \text{ are } B.
\]

First, we draw Venn diagrams from the Boolean standpoint for the premise and conclusion:

```
<table>
<thead>
<tr>
<th>All A are B.</th>
<th>Some A are B.</th>
</tr>
</thead>
</table>
| \[\begin{array}{c}
A \hspace{2cm} B
\end{array}\]
| \[\begin{array}{c}
A \hspace{2cm} B
X
\end{array}\]
```

The information of the conclusion diagram is not represented in the premise diagram, so the inference form is not valid from the Boolean standpoint. Thus, noting that the conclusion is particular, we adopt the Aristotelian standpoint and assume for the moment that the subject of the premise (A) denotes at least one existing thing. This thing is represented by placing a circled X in the open area of that circle:

```
<table>
<thead>
<tr>
<th>All A are B.</th>
<th>Some A are B.</th>
</tr>
</thead>
</table>
| \[\begin{array}{c}
A \hspace{2cm} B
\end{array}\]
| \[\begin{array}{c}
A \hspace{2cm} B
X
\end{array}\]
```

Now the information of the conclusion diagram \textit{is} represented in the premise diagram. Thus, the inference form is conditionally valid from the Aristotelian standpoint. It is valid on condition that the circled X represents at least one existing thing.

To test a complete inference we begin by testing its form. Here is an example:

\[
\text{No penguins are birds that can fly.}
\]
Therefore, it is false that all penguins are birds that can fly.

First, we reduce the immediate inference to its form and test it from the Boolean standpoint:

<table>
<thead>
<tr>
<th>No ( P ) are ( B ).</th>
<th>( P ) ( \cap ) ( B )</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is false that all ( P ) are ( B ).</td>
<td>( P ) ( \cap ) ( B )</td>
</tr>
</tbody>
</table>

Since the inference form is not valid from the Boolean standpoint, we adopt the Aristotelian standpoint and assume for the sake of this test that the subject of the premise (\( P \)) denotes at least one existing thing:

<table>
<thead>
<tr>
<th>No ( P ) are ( B ).</th>
<th>( P ) ( \cap ) ( B )</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is false that all ( P ) are ( B ).</td>
<td>( P ) ( \cap ) ( B )</td>
</tr>
</tbody>
</table>

The Venn diagrams show that the inference form is conditionally valid from the Aristotelian standpoint. It is valid on condition that the circled X represents at least one existing thing. Since the circled X is in the \( P \) circle, the final step is to see if the term in the inference corresponding to \( P \) denotes something that exists. The term in question is "penguins," and at least one penguin actually exists. Thus, the condition is fulfilled, and the inference is valid from the Aristotelian standpoint.

Another example:

All sugarplum fairies are delicate creatures.
Therefore, some sugarplum fairies are delicate creatures.

This immediate inference has the same form as the first one we tested. The form is not valid from the Boolean standpoint, but it is conditionally valid from the Aristotelian standpoint.
The final step is to see if the circled X represents at least one existing thing. The circled X is in the S circle and S stands for “sugarplum fairies,” which do not exist. Thus, the requisite condition is not fulfilled, and the inference is not valid from the Aristotelian standpoint. The inference commits the existential fallacy from the Aristotelian standpoint.

The steps involved in testing an immediate inference from the Aristotelian standpoint may now be summarized:

1. Reduce the inference to its form and test it from the Boolean standpoint. If the form is valid, proceed no further. The inference is valid from both standpoints.

2. If the inference form is invalid from the Boolean standpoint and has a particular conclusion, then adopt the Aristotelian standpoint and look to see if the left-hand premise circle is partly shaded. If it is, enter a circled X in the unshaded part and retest the form.

3. If the inference form is conditionally valid, determine if the circled X represents something that exists. If it does, the condition is fulfilled, and the inference is valid from the Aristotelian standpoint. If it does not, the inference is invalid, and it commits the existential fallacy from the Aristotelian standpoint.

Exercise 4.6

1. Use the modified Venn diagram technique to determine if the following immediate inference forms are valid from the Boolean standpoint, conditionally valid from the Aristotelian standpoint, or invalid.

   1. Some A are not B.
      Therefore, no A are B.

   2. It is false that some A are B.
      Therefore, it is false that all A are B.

   3. It is false that no A are B.
      Therefore, some A are B.

   4. All A are B.
      Therefore, it is false that no A are B.

   5. Some A are B.
      Therefore, it is false that some A are not B.

   6. Some A are not B.
      Therefore, it is false that all A are B.

   7. It is false that some A are B. Therefore, no A are B.

   8. It is false that some A are not B.
Therefore, some $A$ are $B$.

9. It is false that all $A$ are $B$.
   Therefore, no $A$ are $B$.

10. No $A$ are $B$.
    Therefore, some $A$ are not $B$.

II. Use the modified Venn diagram technique to determine if the following immediate inferences are valid from the Boolean standpoint, valid from the Aristotelian standpoint, or invalid. Identify any inferences that commit the existential fallacy from either standpoint.

1. No summer romances are banal pastimes.
   Therefore, it is false that some summer romances are banal pastimes.

2. It is false that some people who hunger for wealth are not victims of their obsession.
   Therefore, some people who hunger for wealth are victims of their obsession.

3. No lamps containing genies are ordinary sources of light.
   Therefore, some lamps containing genies are not ordinary sources of light.

4. It is false that some duck hunters are animal rights activists.
   Therefore, some duck hunters are not animal rights activists.

5. All repressive political regimes are insults to human dignity.
   Therefore, no repressive political regimes are insults to human dignity.

6. It is false that all skating rinks are playgrounds for amateurs.
   Therefore, some skating rinks are not playgrounds for amateurs.

7. All pixies who slide down moonbeams are fun-loving daredevils.
   Therefore, it is false that no pixies who slide down moonbeams are fun-loving daredevils.

8. It is false that some graduate teaching assistants are not underpaid laborers.
   Therefore, it is false that no graduate teaching assistants are underpaid laborers.

9. Some housing projects are developments riddled with crime.
   Therefore, it is false that no housing projects are developments riddled with crime.

10. It is false that some thunderstorms are quiescent phenomena.
    Therefore, all thunderstorms are quiescent phenomena.

11. No flower gardens are creations that feature skunk weed.
    Therefore, it is false that all flower gardens are creations that feature skunk weed.

12. It is false that no incendiary devices are contraptions that misfire.
    Therefore, some incendiary devices are not contraptions that misfire.

13. It is false that some pet lovers are people who think that animals are mere machines.
    Therefore, it is false that all pet lovers are people who think that animals are mere machines.

14. No werewolves are creatures who lurk about in the daytime.
    Therefore, it is false that all werewolves are creatures who lurk about in the daytime.

15. Some soccer games are not thrilling events to watch.
    Therefore, no soccer games are thrilling events to watch.

4.7 Translating Ordinary Language Statements into Categorical Form

Although few statements that occur in ordinary written and oral expression are categorical propositions in standard form, many of them can be translated into standard-form propositions. Such translation has two chief benefits. The first is that the operations and inferences pertinent to standard-form categorical propositions (contrary, subcontrary, etc.) become applicable
to these statements. The second is that such statements, once translated, are completely clear and unambiguous as to their meaning. Many statements in ordinary language are susceptible to multiple interpretations, and each interpretation represents one possible mode of translation. The effort to translate such statements

discloses the various interpretations and thus helps prevent misunderstanding and confusion.

Translating statements into categorical form is like any other kind of translation in that no set of specific rules will cover every possible form of phraseology. Yet, one general rule always applies: Understand the meaning of the given statement, and then reexpress it in a new statement that has a quantifier, subject term, copula, and predicate term. Some of the forms of phraseology that are typically encountered are terms without nouns, nonstandard verbs, singular propositions, adverbs and pronouns, unexpressed and nonstandard quantifiers, conditional statements, exclusive propositions, “the only,” and exceptive propositions.

1. Terms Without Nouns

The subject and predicate terms of a categorical proposition must contain either a plural noun or a pronoun that serves to denote the class indicated by the term. Nouns and pronouns denote classes, while adjectives (and participles) connote attributes. If a term consists of only an adjective, a plural noun or pronoun should be introduced to make the term genuinely denotative. Examples:

| Some roses are red. | Some roses are red flowers. |
| All tigers are carnivorous | All tigers are carnivorous animals |

2. Nonstandard Verbs

According to the position adopted earlier in this chapter, the only copulas that are allowed in standard-form categorical propositions are “are” and “are not.” Statements in ordinary usage, however, often incorporate other forms of the verb “to be.” Such statements may be translated as the following examples illustrate:

| Some college students will become educated. | Some college students are people who will become educated. |
| Some dogs would rather bark than bite. | Some dogs are animals that would rather bark than bite. |

In other statements no form of the verb “to be” occurs at all. These may be translated as the following examples indicate:

| Some birds fly south during the winter. | Some birds are animals that fly south during the winter. |
| All ducks swim. | All ducks are swimmers. |
| or All ducks are animals that swim. |

3. Singular Propositions

A **singular proposition (statement)** is a proposition that makes an assertion about a specific person, place, thing, or time. Singular propositions are typically translated into

| Some birds fly south during the winter. | Some birds are animals that fly south during the winter. |
| All ducks swim. | All ducks are swimmers. |
| or All ducks are animals that swim. |

A **parameter** is a phrase that, when introduced into a statement, affects the form but not the meaning. Some parameters that may be used to translate singular propositions are these:

people identical to places identical to
things identical to
cases identical to
times identical to

For example, the statement “Socrates is mortal” may be translated as “All people identical to Socrates are people who are mortal.” Because only one person is identical to Socrates, namely Socrates himself, the term “people identical to Socrates” denotes the class that has Socrates as its only member. In other words, it simply denotes Socrates. Such a translation admittedly leaves some of the original information behind, because singular statements usually have existential import, whereas universal statements do not—at least from the Boolean standpoint. But if such translations are interpreted from the Aristotelian standpoint, the existential import is preserved. Here are some examples:

<table>
<thead>
<tr>
<th>George went home.</th>
<th>All people identical to George are people who went home.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandra did not go shopping.</td>
<td>No people identical to Sandra are people who went shopping.</td>
</tr>
<tr>
<td>There is a radio in the bedroom.</td>
<td>All places identical to the bedroom are places there is a radio.</td>
</tr>
<tr>
<td></td>
<td>Some radios are things in the bedroom.</td>
</tr>
<tr>
<td>The moon is full tonight.</td>
<td>All things identical to the moon are things that are full tonight.</td>
</tr>
<tr>
<td></td>
<td>All times identical to tonight are times the moon is full.</td>
</tr>
<tr>
<td>I hate gin.</td>
<td>All people identical to me are people who hate gin.</td>
</tr>
<tr>
<td></td>
<td>All things identical to gin are things that I hate.</td>
</tr>
</tbody>
</table>

In translating singular statements, note that the parameter “people identical to” is not the same as “people similar to” or “people like.” There may be many people like Socrates, but there is only one person identical to Socrates. Also note that parameters should not be used when the term in question already has a plural noun (or pronoun) that denotes the intended class. Such use is not wrong, technically, but it is redundant. Example:

Diamonds are carbon allotropes. **Correct:** All diamonds are carbon allotropes. **Redundant:** All things identical to diamonds are things identical to carbon allotropes.

4. Adverbs and Pronouns

When a statement contains a spatial adverb such as “where,” “wherever,” “anywhere,” “everywhere,” or “nowhere,” or a temporal adverb such as “when,” “whenever,” “anytime,” “always,” or “never,” it may be translated in terms of “places” or “times,” respectively. Statements containing pronouns such as “who,” “whoever,” “anyone,” “what,” “whatever,” or “anything” may be translated in terms of “people” or “things,” respectively. Examples:

<table>
<thead>
<tr>
<th>He always wears a suit to work.</th>
<th>All times he goes to work are times he wears a suit.</th>
</tr>
</thead>
<tbody>
<tr>
<td>He is always clean shaven.</td>
<td>All times are times he is clean shaven.</td>
</tr>
<tr>
<td>She never brings her lunch to school.</td>
<td>No times she goes to school are times she brings her lunch.</td>
</tr>
<tr>
<td>Nowhere on earth are there any unicorns.</td>
<td>No places on earth are places there are unicorns.</td>
</tr>
<tr>
<td>Whoever works hard will succeed.</td>
<td>All people who work hard are people who will succeed.</td>
</tr>
<tr>
<td>Whenever he wins he celebrates.</td>
<td>All times he wins are times he celebrates.</td>
</tr>
<tr>
<td>She goes where she chooses.</td>
<td>All places she chooses to go are places she goes.</td>
</tr>
<tr>
<td>She does what she wants.</td>
<td>All things she wants to do are things she does.</td>
</tr>
</tbody>
</table>

Notice the order of the subject and predicate terms in the last four examples. When translating statements such as these it is often easy to confuse the subject term with the predicate term. However, since these statements are all translated as A type categorical propositions, such a mix-up amounts to committing the fallacy of illicit conversion. To prevent it from happening, keep this rule in mind: For “W” words (“who,” “what,” “when,” “where,” “whoever,” “someone,” “whenever,” “whenever,” “wherever”), the
5. Unexpressed Quantifiers

Many statements in ordinary usage have quantifiers that are implied but not expressed. In introducing the quantifiers one must be guided by the most probable meaning of the statement. Examples:

<table>
<thead>
<tr>
<th>Statement</th>
<th>Categorical Proposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emeralds are green gems.</td>
<td>All emeralds are green gems.</td>
</tr>
<tr>
<td>There are lions in the zoo.</td>
<td>Some lions are animals in the zoo.</td>
</tr>
<tr>
<td>A tiger is a mammal.</td>
<td>All tigers are mammals.</td>
</tr>
<tr>
<td>A fish is not a mammal.</td>
<td>No fish are mammals.</td>
</tr>
<tr>
<td>A tiger roared.</td>
<td>Some tigers are animals that roared.</td>
</tr>
<tr>
<td>Children are human beings.</td>
<td>All children are human beings.</td>
</tr>
<tr>
<td>Children live next door.</td>
<td>Some children are people who live next door</td>
</tr>
</tbody>
</table>

6. Nonstandard Quantifiers

In some ordinary language statements, the quantity is indicated by words other than the three standard-form quantifiers. Such words include “few,” “a few,” “not every,” “anyone,” and various other forms. Another problem occurs when the quantifier “all” is combined with the copula “are not.” As we have already seen, statements of the form “All S are not P” are not standard-form propositions. Depending on their meaning, they should be translated as either “No S are P” or “Some S are not P.” When the intended meaning is “Some S are not P,” the meaning may be indicated by placing oral emphasis on the word “all.” For example, “All athletes are not superstars” means “Some athletes are not superstars.” Here are some additional examples:

<table>
<thead>
<tr>
<th>Statement</th>
<th>Categorical Proposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>A few soldiers are heroes.</td>
<td>Some soldiers are heroes.</td>
</tr>
<tr>
<td>Anyone who votes is a citizen.</td>
<td>All voters are citizens.</td>
</tr>
<tr>
<td>Not everyone who votes is a Democrat.</td>
<td>Some voters are not Democrats.</td>
</tr>
<tr>
<td>Not a single dog is a cat.</td>
<td>No dogs are cats.</td>
</tr>
<tr>
<td>All newborns are not able to talk.</td>
<td>No newborns are people able to talk.</td>
</tr>
<tr>
<td>All prisoners are not violent.</td>
<td>Some prisoners are not violent people.</td>
</tr>
<tr>
<td>Many entertainers are comedians.</td>
<td>Some entertainers are comedians.</td>
</tr>
<tr>
<td>Several demonstrators were arrested.</td>
<td>Some demonstrators are people who were arrested.</td>
</tr>
<tr>
<td>Few sailors entered the regatta.</td>
<td>Some sailors are people who entered the regatta and some sailors are not people who entered the regatta.</td>
</tr>
</tbody>
</table>

Notice that this last statement beginning with “few” cannot be translated as a single categorical proposition. Such statements (and some beginning with “a few”) must be translated as a compound arrangement of an I proposition and an O proposition. Statements beginning with “almost all” and “not quite all” must be handled in the same way. When these statements occur in arguments, the arguments must be treated in the same way as those containing exceptive propositions, which will be discussed shortly.

7. Conditional Statements

When the antecedent and consequent of a conditional statement refer to the same class of things, the statement can usually be translated into categorical form. Such statements are always translated as universals. Language following the word “if” goes in the subject term of the categorical proposition, and language following “only if” goes in the predicate term. Examples:
If it's a mouse, then it's a mammal. All mice are mammals.
If a bear is hungry, then it is dangerous. All hungry bears are dangerous animals.
Jewelry is expensive if it is made of gold. All pieces of jewelry made of gold are expensive things.
A car is a Camry only if it's a Toyota. All Camrys are Toyotas.

Conditional statements having a negated consequent are usually best translated as E propositions. Examples:

| If it's a turkey, then it's not a mammal. | No turkeys are mammals. |
| If an animal has four legs, then it is not a bird. | No four-legged animals are birds. |
| A knife will cut only if it isn't dull. | No knives that cut are dull knives. |

The word “unless” means “if not.” Since language following the word “if” goes in the subject, statements containing “unless” are translated as categorical propositions having negated subject terms. Examples:

| Tomatoes are edible unless they are spoiled. | All unspoiled tomatoes are edible tomatoes. |
| Unless a boy misbehaves he will be treated decently. | All boys who do not misbehave are boys who will be treated decently. |

8. Exclusive Propositions

Many propositions that involve the words “only,” “none but,” “none except,” and “no…” except” are exclusive propositions. Efforts to translate them into categorical propositions often lead to confusing the subject term with the predicate term. To avoid such confusion keep in mind that language following “only,” “none but,” “none except,” and “no… except” goes in the predicate term of the categorical proposition. For example, the statement “Only executives can use the silver elevator” is translated “All people who can use the silver elevator are executives.” If it were translated “All executives are people who can use the silver elevator,” the translation would be incorrect. Examples:

| Only elected officials will attend the convention. | All people who will attend the convention are elected officials. |
| None but the brave deserve the fair. | All people who deserve the fair are brave people. |
| No birds except peacocks are proud of their tails. | All birds proud of their tails are peacocks. |
| He owns only blue-chip stocks. | All stocks he owns are blue-chip stocks. |
| She invited only wealthy socialites. | All people she invited are wealthy socialites. |

For a statement involving “only,” “none but,” “none except,” and “no… except” to be a genuinely exclusive proposition, the word that follows these words must be a plural noun or pronoun. If the word that follows “only,” “none but,” or the like designates an individual, the statement really asserts two things. For example, the statement “Only Megan painted a picture” asserts that Megan painted a picture and that no other person painted a picture. Thus it would be translated as two statements: “All people identical to Megan are people who painted a picture, and all people who painted a picture are people identical to Megan.” This section of the book will ignore cases where the word following “only,” “none but,” or the like designates an individual.

Also note that many English statements containing “only” are ambiguous because “only” can be interpreted as modifying alternate words in the statement. Consider, for example, the statement “He only jogs after sunset.” Does this mean “He is the only person who jogs after sunset” or “He jogs and does not walk after sunset” or “The only time he jogs is after sunset”? If the statement’s context does not provide an answer, the translator is free to pick any of these senses for translation. This same ambiguity, incidentally, affects the last two examples in the earlier list. Accordingly, they might also be translated “All things he owns are blue-chip stocks” and “All socialites she invited are wealthy people.”

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9. “The Only”

Statements beginning with the words “the only” are translated differently from those beginning with “only.” For example, the statement “The only cars that are available are Chevrolets” means “If a car is available, then it is a Chevrolet.” This in turn is translated as “All cars that are available are Chevrolets.” In other words, language following “the only” goes in the subject term of the categorical proposition. Examples:

| The only animals that live in this canyon are skunks. | All animals that live in this canyon are skunks. |
| Accountants are the only ones who will be hired. | All those who will be hired are accountants. |

Statements involving “the only” are similar to those involving “only” in this one respect: When the statement is about an individual, two statements are needed to translate it. For example, “The only person who painted a picture is Megan” means that Megan painted a picture, and no other person painted a picture. The statement is equivalent in meaning to “Only Megan painted a picture.” Thus, it is translated “All people identical to Megan are people who painted a picture, and all people who painted a picture are people identical to Megan.” Statements involving “the only” that refer to individuals are ignored throughout the remainder of this chapter.

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10. Exceptional Propositions

Propositions of the form “All except S are P” and “All but S are P” are exceptional propositions. They must be translated not as single categorical propositions but as pairs of conjoined categorical propositions. Statements that include the phrase “none except,” on the other hand, are exclusive (not exceptional) propositions. “None except” is synonymous with “none but.” Here are some examples of exceptional propositions:

| All except students are invited. | No students are invited people, and all nonstudents are invited people. |
| All but managers must report to the president. | No managers are people who must report to the president, and all nonmanagers are people who must report to the president. |

Because exceptional propositions cannot be translated into single categorical propositions, many of the simple inferences and operations pertinent to categorical propositions cannot be applied to them. Arguments that contain exceptional propositions as premises or conclusion can be evaluated only through the application of extended techniques. This topic is taken up in the next chapter.

<table>
<thead>
<tr>
<th>Key word(to be eliminated)</th>
<th>Translation hint</th>
</tr>
</thead>
<tbody>
<tr>
<td>whoever, wherever, always, anyone, never, etc.</td>
<td>use “all” together with people, places, times</td>
</tr>
<tr>
<td>a few, several, many</td>
<td>use “some”</td>
</tr>
<tr>
<td>if... then</td>
<td>use “all” or “no”</td>
</tr>
<tr>
<td>unless</td>
<td>use “if not”</td>
</tr>
<tr>
<td>only, none but, none except, no... except</td>
<td>use “all”</td>
</tr>
<tr>
<td>the only</td>
<td>use “all”</td>
</tr>
<tr>
<td>all but, all except, few</td>
<td>two statements required</td>
</tr>
<tr>
<td>not every, not all</td>
<td>use “some... are not”</td>
</tr>
<tr>
<td>there is, there are</td>
<td>use “some”</td>
</tr>
</tbody>
</table>

Rule for A propositions

Language following these words goes in the subject term: “if,” “the only,” and “W” words (“who,” “what,” “when,” “where,” “whoever,” “whatever,” “whenever,” “wherever”).

Language following these words goes in the predicate term: “only if,” “only,” “none but,” “none except,” and “no... except.”

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Exercise 4.7

1. Translate the following into standard-form categorical propositions.

   1. Any bank that makes too many risky loans will fail.
   2. Temporary workers are not eligible for fringe benefits.
   3. Terrorist attacks succeed whenever security measures are lax.

   4. Bromine is extractable from seawater.

   5. Not all guilt feelings are psychological aberrations.


   7. If it's a halogen, then it isn't chemically inert.

   8. A television show that depicts violence incites violence.

   9. Manipulators do not make good marriage partners.

   10. None but pirate ships fly the Jolly Roger.

   11. She gains weight whenever she's depressed.

   12. She's depressed whenever she gains weight.

   13. A man is a bachelor only if he is unmarried.


   16. A few organic silicones are used as lubricants.

   17. Only nuclear-powered vehicles are suitable for deep-space exploration.

   18. Comets are the only heavenly bodies with tails.

   19. There is a giant star in the Tarantula Nebula.

   20. If a pregnant woman drinks alcohol, she risks giving birth to a deformed child.

   21. No shellfish except oysters make pearls.

   22. Only diabetics require insulin treatments.

   23. The electroscope is a device for detecting static electricity.

   24. Occasionally there are concerts in Central Park.

   25. Berlin was the setting for the 1936 Olympic Games.

   26. The Kentucky Derby is never run in January.

   27. The only way to get rid of a temptation is to yield to it.

   28. Where there's smoke, there's fire.

   29. Lunar eclipses do not occur unless the moon is full.

   30. Radio transmissions are disrupted whenever sunspot activity increases.
31. If an ore isn't radioactive, then it isn't pitchblende.
32. All but the rats left the sinking ship.
33. A pesticide is dangerous if it contains DDT.
34. John Grisham writes only novels about lawyers.
35. He who hesitates is lost.
36. Modern corporations are all run in the interest of their managers.
37. Unless the sun is shining, a rainbow cannot occur.
38. Whoever suffers allergic reactions has a weakened immune system.
39. All fruits except pineapples ripen after they are picked.
40. Few corporate raiders are known for their integrity.
41. Monkeys are found in the jungles of Guatemala.
42. Monkeys are mammals.
43. I like strawberries.
44. All passengers are not allowed to smoke on board the aircraft.
45. All flowers are not fragrant.
46. Cynthia travels where she wants.
47. Bats are the only true flying mammals.
48. Not every river runs to the sea.
49. Physicists do not understand the operation of superconductors.
50. Many apartment dwellers are victimized by noise.
51. There are forced labor camps in China.
52. Whatever increases efficiency improves profitability.
53. Dolphins are swimming between the breakers.
54. Feathers are not heavy.
55. Few picnics are entirely free of ants.
56. A civil right is unalienable if it is a human right.
57. She says what she pleases.
58. Several contestants won prizes.
59. An animal is a feline only if it is a cat.
60. Renee does whatever she is told to do.

II. The following exercises contain typical mistakes that students make in attempting to translate statements into standard
form. Correct the errors and redundancies in these attempted translations.

1. Some of the figure skating finalists are performers who are athletes that may win medals.
2. All cars identical to BMWs are the only cars that young lawyers drive.
3. All vertebrates except cartilaginous fishes are animals with a bony skeleton.
4. No downhill skiers are effective competitors if they suffer from altitude sickness.
5. All substances like cobalt are things that are substances identical to ferromagnetic metals.

6. No people identical to nuclear pacifists are people who believe a just war is possible.
7. All people identical to matadors are not performers who succumb easily to fear.
8. All companies identical to Google are looking forward to a bright future.
9. No toxic dumps are ecological catastrophes unless they leak.
10. All crocodiles are things identical to dangerous animals when they are hungry.

Translating Ordinary Language Statements into Categorical Form: Summary

Categorical Proposition: A proposition that relates two classes (or categories). Standard-form categorical propositions occur in four forms and are identified by letter names:

- **A**: All S are P.
- **E**: No S are P.
- **I**: Some S are P.
- **O**: Some S are not P.

Every standard-form categorical proposition has four components:

- Quantifier (“all,” “no,” “some”).
- Subject Term.
- Copula (“are,” “are not”).
- Predicate Term.

The **quality** of a categorical proposition:

- Affirmative (All S are P, Some S are P).
- Negative (No S are P, Some S are not P).

The **quantity** of a categorical proposition:

- Universal (All S are P, No S are P).
- Particular (Some S are P, Some S are not P).

The subject and predicate terms are distributed if the proposition makes an assertion about every member of the class denoted by the term; otherwise, undistributed:

- **A**: Subject term is distributed.
- **E**: Subject and predicate terms are distributed.
- **I**: Neither term is distributed.
- **O**: Predicate term is distributed.

Universal (A and E) propositions allow for two different interpretations:
Aristotelian: Universal propositions about existing things have existential import.
Boolean: Universal propositions have no existential import.

The modern square of opposition is a diagram that represents necessary inferences from the Boolean standpoint:

- A and O propositions contradict each other.
- E and I propositions contradict each other.

The content of categorical propositions may be represented by two-circle Venn diagrams:

- Shading an area indicates that the area is empty.
- Entering an X in an area means that the area is not empty.

Using Venn diagrams to test an immediate inference:

- Enter the content of the premise and conclusion in separate Venn diagrams.
- See if the content of the conclusion diagram is contained in the premise diagram.

Three operations that sometimes yield logically equivalent results:

- Conversion: Switch S and P. Logically equivalent results for E, I.
- Obversion: Change the quality, replace P with its term complement. Logically equivalent results for A, E, I, O.
- Contraposition: Switch S and P, replace S and P with term complements. Logically equivalent results for A, O.

Two formal fallacies may occur when these operations are used to derive conclusions:

- Illicit conversion: Performing conversion on an A or O premise.
- Illicit contraposition: Performing contraposition on an E or I premise.

The traditional square of opposition applies to categorical propositions when the Aristotelian standpoint is adopted and the subject term refers to existing things:

- Contrary: Holds between A and E. At least one is false.
- Subcontrary: Holds between I and O. At least one is true.
- Subalternation: Holds between A and I and between E and O. Truth flows downward and falsity flows upward.
- Contradiction: Holds as in the modern square.

Three formal fallacies may occur when the traditional square is used to derive conclusions:

- Illicit Contrary: Results from an incorrect application of Contrary.
- Illicit Subcontrary: Results from an incorrect application of Subcontrary.
- Illicit Subalternation: Results from an incorrect application of Subalternation.

Existential fallacy: Occurs when Contrary, Subcontrary, or Subalternation are used on premises whose subject terms refer to nonexistent things.

Venn diagrams may be modified to apply to the Aristotelian standpoint:

- For A and E: Enter a circled X in the unshaded part of the subject circle.
- The circled X represents the temporary assumption of existence.
- May be used to prove the traditional square and test immediate inferences.

Translation: Propositions not in standard form may be put into standard form.

- Translation must have a proper quantifier, subject term, copula, predicate term.
- Translate singular propositions by using a parameter.
- Translate adverbs and pronouns by using "persons," "places," "things," "times."
- For A propositions:
  - Language following "if," "the only," and "W" words goes in the subject term.
  - Language following "only if," "only," "none but," "none except," and "no... except" goes in the predicate term.

Footnotes

* In general, we interpret this openness to existence as extending to the subject class, the predicate class, and the complements.
of these classes. However, in the present account we confine our attention to the subject class. The concept of class complement is discussed in Section 4.4 (Obversion).

† In ordinary language, the word “some” occasionally implies something less than actual existence. For example, the statement “Some unicorns are tenderhearted” does not seem to suggest that unicorns actually exist, but merely that among the group of imaginary things called “unicorns,” there is a subclass of tenderhearted ones. In the vast majority of cases, however, “some” in ordinary language implies existence. The logical “some” conforms to these latter uses.

* In many mathematics texts, shading an area of a Venn diagram indicates that the area is not empty. The significance of shading in logic is exactly the opposite.

* The modified Venn diagram technique can also be used to prove the validity of conversion, obversion, and contraposition from the Aristotelian standpoint, but to do so a circled X must be entered in the unshaded part of both the S and P circles and also in the unshaded area outside both circles.

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