Categorical Syllogisms

5.1 Standard Form, Mood, and Figure

Key terms are introduced in boldface and defined in the glossary.

Online resources supplement each chapter with self-study tools such as flashcards, quizzes, interactive Venn diagrams, and truth tables/trees. Students can also access Logic Coach and Learning Logic self-study programs.

In the general sense of the term, a syllogism is a deductive argument consisting of two premises and one conclusion. Provisionally we will define a categorical syllogism as a syllogism consisting of three categorical propositions and containing a total of three different terms, each of which appears twice in distinct propositions. (We will give a more precise definition shortly.) The following argument is a categorical syllogism:

All soldiers are patriots.
No traitors are patriots.
Therefore, no traitors are soldiers.

Each of the three terms in a categorical syllogism has its own name depending on its position in the argument. The major term, by definition, is the predicate of the conclusion, and the minor term is the subject of the conclusion. The middle term, which provides the middle ground between the two premises, is the one that occurs once in each premise and does not occur in the conclusion. Thus, for the argument just given, the major term is “soldiers,” the minor term is “traitors,” and the middle term is “patriots.”

The premises of a categorical syllogism also have their own names. The major premise, by definition, is the one that contains the major term, and the minor premise is the one that contains the minor term. Thus, in the syllogism just given the major premise is “All soldiers are patriots,” and the minor premise is “No traitors are patriots.”
Now that we are supplied with these definitions, we may proceed to the idea of standard form. A **standard-form categorical syllogism** is one that meets the following four conditions:

1. All three statements are standard-form categorical propositions.
2. The two occurrences of each term are identical.
3. Each term is used in the same sense throughout the argument.
4. The major premise is listed first, the minor premise second, and the conclusion last.

The first condition requires that each statement have a proper quantifier, subject term, copula, and predicate term. The second condition is clear. The third rules out the possibility of equivocation. For example, if a syllogism containing the word “men” used that term in the sense of human beings in one statement and in the sense of male human beings in another statement, the syllogism would really contain more than three terms and would therefore not be in standard form. Finally, the fourth condition merely requires that the three statements be listed in the right order.

The syllogism about soldiers is in standard form because all four conditions are fulfilled. However, the following syllogism is not in standard form, because the fourth condition is violated:

\[
\text{All watercolors are paintings.} \\
\text{Some watercolors are masterpieces.} \\
\text{Therefore, some paintings are masterpieces.}
\]

To put this syllogism into standard form the order of the premises must be reversed. The major premise (the one containing “masterpieces,” which is the predicate term in the conclusion) must be listed first, and the minor premise (the one containing “paintings,” which is the subject term in the conclusion) must be listed second.

Now that we have a definition of standard-form categorical syllogism, we can give a more precise definition of categorical syllogism. A **categorical syllogism** is a deductive argument consisting of three categorical propositions that is capable of being translated into standard form. For an argument to qualify as a categorical syllogism, all three statements need not be standard-form categorical propositions; but if they are, the analysis is greatly simplified. For this reason, all of the syllogisms presented in the first four sections of this chapter will consist of statements that are in standard form.
form. In later sections, techniques will be developed for translating non-standard-form syllogisms into equivalent arguments that are in standard form.

After a categorical syllogism has been put into standard form, its validity or invalidity may be determined through mere inspection of the form. The individual form of a syllogism consists of two factors: mood and figure. The mood of a categorical syllogism consists of the letter names of the propositions that make it up. For example, if the major premise is an $A$ proposition, the minor premise an $O$ proposition, and the conclusion an $E$ proposition, the mood is $AOE$. To determine the mood of a categorical syllogism, one must first put the syllogism into standard form; the letter name of the statements may then be noted to the side of each. The mood of the syllogism is then designated by the order of these letters, reading the letter for the major premise first, the letter for the minor premise second, and the letter for the conclusion last.

The figure of a categorical syllogism is determined by the location of the two occurrences of the middle term in the premises. Four different arrangements are possible. If we let $S$ represent the subject of the conclusion (minor term), $P$ the predicate of the conclusion (major term), and $M$ the middle term, and leave out the quantifiers and copulas, the four possible arrangements may be illustrated as follows:

<table>
<thead>
<tr>
<th>Figure 1</th>
<th>Figure 2</th>
<th>Figure 3</th>
<th>Figure 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>$M$ $P$</td>
<td>$P$ $M$</td>
<td>$M$ $P$</td>
<td>$P$ $M$</td>
</tr>
<tr>
<td>$S$ $M$</td>
<td>$S$ $M$</td>
<td>$M$ $S$</td>
<td>$M$ $S$</td>
</tr>
<tr>
<td>$S$ $P$</td>
<td>$S$ $P$</td>
<td>$S$ $P$</td>
<td>$S$ $P$</td>
</tr>
</tbody>
</table>

In the first figure the middle term is top left, bottom right; in the second, top right, bottom right, and so on. Example:

- No painters are sculptors.
- Some sculptors are artists.
- Therefore, some artists are not painters.

This syllogism is in standard form. The mood is $EIO$ and the figure is four. The form of the syllogism is therefore designated as $EIO-4$.

To remember how the four figures are defined, imagine the four possible arrangements of the middle term as depicting the outline of a shirt collar:

- The only problem with this device is that it may lead you to confuse the second figure with the third. To avoid this confusion, keep in mind that for these two figures the $S$ and $P$ terms go on the same “collar flap” as the middle term. Thus, for the second figure, $S$ and $P$ are to the left of the middle term, and for the third figure they are to the right.
Since there are four kinds of categorical propositions and there are three categorical propositions in a categorical syllogism, there are 64 possible moods \((4 \times 4 \times 4 = 64)\). And since there are four different figures, there are 256 different forms of categorical syllogisms \((4 \times 64 = 256)\).

Once the mood and figure of a syllogism is known, the validity of the syllogism can be determined by checking the mood and figure against a list of valid syllogistic forms. To do this, first adopt the Boolean standpoint and see if the syllogism’s form appears in the following table of unconditionally valid forms. If it does, the syllogism is valid from the Boolean standpoint. In other words, it is valid regardless of whether its terms denote actually existing things.

### UNCONDITIONALLY VALID FORMS

<table>
<thead>
<tr>
<th>Figure 1</th>
<th>Figure 2</th>
<th>Figure 3</th>
<th>Figure 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>EAE</td>
<td>IAI</td>
<td>AEE</td>
</tr>
<tr>
<td>EAE</td>
<td>AEE</td>
<td>AII</td>
<td>IAI</td>
</tr>
<tr>
<td>AII</td>
<td>EIO</td>
<td>OAO</td>
<td>EIO</td>
</tr>
<tr>
<td>EIO</td>
<td>AOO</td>
<td>EIO</td>
<td></td>
</tr>
</tbody>
</table>

If the syllogism does not appear on the list of unconditionally valid forms, then adopt the Aristotelian standpoint and see if the syllogism’s form appears in the following table of conditionally valid forms. If it does, the syllogism is valid from the Aristotelian standpoint on condition that a certain term (the “critical” term) denotes actually existing things. The required condition is stated in the last column.

### CONDITIONALLY VALID FORMS

<table>
<thead>
<tr>
<th>Figure 1</th>
<th>Figure 2</th>
<th>Figure 3</th>
<th>Figure 4</th>
<th>Required condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAI</td>
<td>AEO</td>
<td>AEO</td>
<td></td>
<td>(S) exists</td>
</tr>
<tr>
<td>EAO</td>
<td>EAO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AAI</td>
<td>EAO</td>
<td>EAO</td>
<td></td>
<td>(M) exists</td>
</tr>
<tr>
<td>EAO</td>
<td></td>
<td></td>
<td>AAI</td>
<td>(P) exists</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For example, the AAI-1 is valid from the Aristotelian standpoint if the subject of the conclusion (the minor term) denotes actually existing things. The EAO-3 is valid if the middle term denotes actually existing things. Thus, if we are given an AAI-1 syllogism and the minor term is “cats,” then the syllogism is valid from the Aristotelian standpoint. But if the minor term is “unicorns,” then the syllogism is invalid. On the other hand, if the minor term is “students who failed the exam” and we are not certain if there are any such students, then the syllogism is conditionally valid.
The relationship between the Aristotelian standpoint and the Boolean standpoint is illustrated in the following bar graph:

The graph shows that when the premises of a syllogistic form are recognized as conveying information about existence, an additional nine forms become valid.

Interestingly, during the Middle Ages logic students used to memorize a little poem that served as a rule of thumb for distinguishing valid from invalid syllogisms. The vowels in the words identified the mood, and the words “prioris,” “secundae,” and so on the figure.

Barbara, Celarent, Darii, Ferioque prioris;
Cesare, Camestres, Festino, Baroco secundae;
Tertia, Darapti, Disamis, Datisi, Felapton,
Bocardo, Ferison habet: quarta insuper addit
Bramantip, Camenes, Dimaris, Fesapo, Fresison.

For example, the “Barbara” syllogism (this designation is still encountered today) is AAA-1, “Celarent” is EAE-1, and so on. This poem conforms substantially to the two tables given earlier, except that five forms have been left out. The reason these forms were left out is that the logicians of that time considered them weak: They draw a particular conclusion from premises that would support a (stronger) universal conclusion. For example, the weaker AAI-1 is left out in favor of the stronger AAA-1.

Needless to say, few students today depend on this poem to distinguish valid from invalid syllogisms.

We have seen how, given the syllogism, we can obtain the mood and figure. But sometimes we need to go in the reverse direction: from the mood and figure to the syllogistic form. Suppose we are given the form EIO-4. To reconstruct the syllogistic form is easy. First use the mood to determine the skeleton of the form:

- **E** No ______ are ______.
- **I** Some ______ are ______.
- **O** Some ______ are not ______.
Then use the figure to determine the arrangement of the middle terms:

\[ E \quad \text{No} \quad \underline{\quad} \text{are} \quad M. \]
\[ I \quad \text{Some} \quad M \quad \text{are} \quad \underline{\quad}. \]
\[ O \quad \text{Some} \quad \underline{\quad} \quad \text{are not} \quad \underline{\quad}. \]

Finally, supply the major and minor terms, using the letters \( S \) and \( P \) to designate the subject and predicate of the conclusion. The predicate of the conclusion is always repeated in the first premise, and the subject of the conclusion is repeated in the second premise:

\[ E \quad \text{No} \quad P \quad \text{are} \quad M. \]
\[ I \quad \text{Some} \quad M \quad \text{are} \quad S. \]
\[ O \quad \text{Some} \quad S \quad \text{are not} \quad P. \]

**EXERCISE 5.1**

I. The following syllogisms are in standard form. Identify the major, minor, and middle terms, as well as the mood and figure of each. Then use the two lists of valid syllogistic forms to determine whether each is valid from the Boolean standpoint, valid from the Aristotelian standpoint, or invalid.

1. **★** All neutron stars are things that produce intense gravity.
   All neutron stars are extremely dense objects.
   Therefore, all extremely dense objects are things that produce intense gravity.

2. No insects that eat mosquitoes are insects that should be killed.
   All dragonflies are insects that eat mosquitoes.
   Therefore, no dragonflies are insects that should be killed.

3. No environmentally produced diseases are inherited afflictions.
   Some psychological disorders are not inherited afflictions.
   Therefore, some psychological disorders are environmentally produced diseases.

4. No people who mix fact with fantasy are good witnesses.
   Some hypnotized people are people who mix fact with fantasy.
   Therefore, some hypnotized people are not good witnesses.

5. All ozone molecules are good absorbers of ultraviolet rays.
   All ozone molecules are things destroyed by chlorine.
   Therefore, some things destroyed by chlorine are good absorbers of ultraviolet rays.

II. Put the following syllogisms into standard form, using letters to represent the terms, and name the mood and figure. Then use the two lists of valid syllogistic forms to determine whether each is valid from the Boolean standpoint, valid from the Aristotelian standpoint, or invalid.
1. No Republicans are Democrats, so no Republicans are big spenders, since all big spenders are Democrats.

2. Some latchkey children are not kids who can stay out of trouble, for some youngsters prone to boredom are latchkey children, and no kids who can stay out of trouble are youngsters prone to boredom.

3. No rent-control proposals are regulations welcomed by landlords, and all regulations welcomed by landlords are measures that allow a free hand in raising rents. Therefore, some rent-control proposals are measures that allow a free hand in raising rents.

4. Some insects that feed on milkweed are not foods suitable for birds, inasmuch as no monarch butterflies are foods suitable for birds and all monarch butterflies are insects that feed on milkweed.

5. No illegal aliens are people who have a right to welfare payments, and some migrant workers are illegal aliens. Thus, some people who have a right to welfare payments are migrant workers.

6. Some African nations are not countries deserving military aid, because some African nations are not upholders of human rights, and all countries deserving military aid are upholders of human rights.

7. All pranksters are exasperating individuals, consequently some leprechauns are exasperating individuals, since all leprechauns are pranksters.

8. Some racists are not people suited to be immigration officials, given that some humanitarians are not people suited to be immigration officials, and no humanitarians are racists.

9. No people who respect human life are terrorists, and all airline hijackers are terrorists. Hence, no airline hijackers are people who respect human life.

10. Some silicates are crystalline substances, because all silicates are oxygen compounds, and some oxygen compounds are not crystalline substances.

III. Reconstruct the syllogistic forms from the following combinations of mood and figure.

★ 1. OAE-3
   2. EIA-4
   3. AII-3
   ★ 4. IAE-1
   5. AOO-2
   6. EAO-4
   ★ 7. AAA-1
   8. EAO-2
   9. OEI-3
   ★ 10. OEA-4
IV. Construct the following syllogisms.

1. An EIO-2 syllogism with these terms: major: dogmatists; minor: theologians; middle: scholars who encourage free thinking.

2. An unconditionally valid syllogism in the first figure with a particular affirmative conclusion and these terms: major: people incapable of objectivity; minor: Supreme Court justices; middle: lockstep ideologues.

3. An unconditionally valid syllogism in the fourth figure having two universal premises and these terms: major: teenage suicides; minor: heroic episodes; middle: tragic occurrences.

4. A valid syllogism having mood OAO and these terms: major: things capable of replicating by themselves; minor: structures that invade cells; middle: viruses.

5. A valid syllogism in the first figure having a universal negative conclusion and these terms: major: guarantees of marital happiness; minor: prenuptial agreements; middle: legally enforceable documents.

V. Answer “true” or “false” to the following statements.

1. Every syllogism is a categorical syllogism.
2. Some categorical syllogisms cannot be put into standard form.
3. The statements in a categorical syllogism need not be expressed in standard form.
4. The statements in a standard-form categorical syllogism need not be expressed in standard form.
5. In a standard-form categorical syllogism the two occurrences of each term must be identical.
6. The major premise of a standard-form categorical syllogism contains the subject of the conclusion.
7. To determine its mood and figure, a categorical syllogism must first be put into standard form.
8. In a standard-form syllogism having Figure 2, the two occurrences of the middle term are on the right.
9. The unconditionally valid syllogistic forms are valid from both the Boolean and the Aristotelian standpoints.
10. The conditionally valid syllogistic forms are invalid if the requisite condition is not fulfilled.

5.2 Venn Diagrams

Venn diagrams provide the most intuitively evident and, in the long run, easiest to remember technique for testing the validity of categorical syllogisms. The technique is basically an extension of the one developed in Chapter 4 to represent the informational
content of categorical propositions. Because syllogisms contain three terms, whereas propositions contain only two, the application of Venn diagrams to syllogisms requires three overlapping circles.

These circles should be drawn so that seven areas are clearly distinguishable within the diagram. The second step is to label the circles, one for each term. The precise order of the labeling is not critical, but we will adopt the convention of always assigning the lower-left circle to the subject of the conclusion, the lower-right circle to the predicate of the conclusion, and the top circle to the middle term. This convention is easy to remember because it conforms to the arrangement of the terms in a standard-form syllogism: The subject of the conclusion is on the lower left, the predicate of the conclusion is on the lower right, and the middle term is in the premises, above the conclusion.

![Venn Diagram](image)

Anything in the area marked “1” is an $M$ but neither an $S$ nor a $P$, anything in the area marked “2” is both an $S$ and an $M$ but not a $P$, anything in the area marked “3” is a member of all three classes, and so on.

The test procedure consists of transferring the information content of the premises to the diagram and then inspecting the diagram to see whether it necessarily implies the truth of the conclusion. If the information in the diagram does do this, the argument is valid; otherwise it is invalid.

The use of Venn diagrams to evaluate syllogisms usually requires a little practice at first. Perhaps the best way of learning the technique is through illustrative examples, but a few pointers are needed first:

1. Marks (shading or placing an X) are entered only for the premises. No marks are made for the conclusion.
2. If the argument contains one universal premise, this premise should be entered first in the diagram. If there are two universal premises, either one can be done first.
3. When entering the information contained in a premise, one should concentrate on the circles corresponding to the two terms in the statement. While the third circle cannot be ignored altogether, it should be given only minimal attention.
4. When inspecting a completed diagram to see whether it supports a particular conclusion, one should remember that particular statements assert two things. “Some $S$ are $P$” means “At least one $S$ exists and that $S$ is a $P$”; “Some $S$ are not $P$” means “At least one $S$ exists and that $S$ is not a $P$."

Section 5.2  Venn Diagrams  267
5. When shading an area, one must be careful to shade *all* of the area in question. Examples:

- **Right:**
- **Wrong:**

6. The area where an X goes is always initially divided into two parts. If one of these parts has already been shaded, the X goes in the unshaded part. Examples:

- **Right:**

If one of the two parts is not shaded, the X goes on the line separating the two parts. Examples:

- **Right:**

This means that the X may be in either (or both) of the two areas—but it is not known which one.

7. An X should never be placed in such a way that it dangles outside of the diagram, and it should never be placed on the intersection of two lines.

- **Wrong:**
- **Wrong:**
John Venn is known mainly for his circle diagrams, which have contributed to work in many areas of mathematics and logic, including computer science, set theory, and statistics. His book *The Logic of Chance* (1866) advanced probability theory by introducing the relative frequency interpretation of probability; it significantly influenced later developments in statistical theory as well. In *Symbolic Logic* (1881) he defended George Boole against various critics and rendered the new logic intelligible to non-mathematical thinkers. Finally, in *The Principles of Empirical and Inductive Logic* (1889) he criticized Mill’s methods of induction as being of limited application as an engine of discovery in science.

John Venn was born in Hull, England, the son of Henry Venn, the Drypool parish rector, and Martha Sykes Venn, who died when Venn was a child. The Venns were prominent members of the evangelical movement within the Church of England. John Venn’s grandfather had been an evangelical leader, as was his father, whom his contemporaries regarded as the head of the evangelical movement. His father served for many years in an administrative capacity for the Church Missionary Society, and John was expected to follow in the family tradition. In 1858, after graduating from Gonville and Caius (pronounced “keys”) College, Cambridge, John Archibald Venn. In 1883, at age forty-nine, Venn became a fellow of the Royal Society and received the degree of Doctor of Science.

The greater part of Venn’s life centered completely on his association with Cambridge. In 1857 he became a fellow of Caius, and he remained a member of the college foundation for sixty-six years, until his death. During the last twenty years of his life he served as college president, during which time he wrote a history of the college. Also, in collaboration with his son, he completed Part I of the massive *Alumni Cantabrigienses*, which contains short biographies of 76,000 graduates and office holders ranging from the university’s earliest days through 1751.

John Venn’s son said of his father that he was a “fine walker and mountain climber.” Also, in keeping with his view that abstract subjects such as logic and mathematics ought to serve practical utility, Venn loved to use this knowledge to build machines. He invented a cricket bowling machine that was used against the best batsman of an Australian team. The machine “clean bowled” this batsman four times. Today Venn is memorialized by a stained glass window in the dining hall of Caius College, which contains a representation of a Venn diagram.
Boolean Standpoint

Because the Boolean standpoint does not recognize universal premises as having existential import, its approach to testing syllogisms is simpler and more general than that of the Aristotelian standpoint. Hence, we will begin by testing syllogisms from that standpoint and later proceed to the Aristotelian standpoint. Here is an example:

1. No $P$ are $M$.
   All $S$ are $M$.
   No $S$ are $P$.

Since both premises are universal, it makes no difference which premise we enter first in the diagram. To enter the major premise, we concentrate our attention on the $M$ and $P$ circles, which are highlighted with color:

We now complete the diagram by entering the minor premise. In doing so, we concentrate our attention on the $S$ and $M$ circles, which are highlighted with color:

The conclusion states that the area where the $S$ and $P$ circles overlap is shaded. Inspection of the diagram reveals that this area is indeed shaded, so the syllogistic form is valid. Because the form is valid from the Boolean standpoint, it is unconditionally valid. In other words, it is valid regardless of whether its premises are recognized as having existential import.

Here is another example:

2. All $M$ are $P$.
   No $S$ are $M$.
   No $S$ are $P$.
Again, both premises are universal, so it makes no difference which premise we enter first in the diagram. To enter the major premise, we concentrate our attention on the $M$ and $P$ circles:

![Venn Diagram]

To enter the minor premise, we concentrate our attention on the $M$ and $S$ circles:

![Venn Diagram]

Again, the conclusion states that the area where the $S$ and $P$ circles overlap is shaded. Inspection of the diagram reveals that only part of this area is shaded, so the syllogistic form is invalid.

Another example:

3. Some $P$ are $M$.
   All $M$ are $S$.
   Some $S$ are $P$.

We enter the universal premise first. To do so, we concentrate our attention on the $M$ and $S$ circles:

![Venn Diagram]
To enter the particular premise, we concentrate our attention on the $M$ and $P$ circles. This premise tells us to place an X in the area where the $M$ and $P$ circles overlap. Because part of this area is shaded, we place the X in the remaining area:

\begin{center}
\includegraphics[width=0.3\textwidth]{syllogism_4.png}
\end{center}

The conclusion states that there is an X in the area where the $S$ and $P$ circles overlap. Inspection of the diagram reveals that there is indeed an X in this area, so the syllogistic form is valid.

The examples that follow are done in a single step.

4. All $P$ are $M$.
   **AOO-2**
   Some $S$ are not $M$.
   Some $S$ are not $P$.

\begin{center}
\includegraphics[width=0.3\textwidth]{syllogism_4_example.png}
\end{center}

The universal premise is entered first. The particular premise tells us to place an X in the part of the $S$ circle that lies outside the $M$ circle. Because part of this area is shaded, we place the X in the remaining area. The conclusion states that there is an X that is inside the $S$ circle but outside the $P$ circle. Inspection of the diagram reveals that there is indeed an X in this area, so the syllogistic form is valid.

5. Some $M$ are $P$.
   All $S$ are $M$.
   Some $S$ are $P$.

\begin{center}
\includegraphics[width=0.3\textwidth]{syllogism_5.png}
\end{center}

As usual, we enter the universal premise first. In entering the particular premise, we concentrate on the area where the $M$ and $P$ circles overlap. (For emphasis, this area is colored in the diagram.) Because this overlap area is divided into two parts (the areas
marked “1” and “2”), we place the X on the line (arc of the S circle) that separates the two parts. The conclusion states that there is an X in the area where the S and P circles overlap. Inspection of the diagram reveals that the single X is dangling outside of this overlap area. We do not know if it is in or out. Thus, the syllogistic form is invalid.

In entering the particular premise, we concentrate our attention on the part of the S circle that lies outside the M circle (colored area). Because this area is divided into two parts (the areas marked “1” and “2”), we place the X on the line (arc of the P circle) separating the two areas. The conclusion states that there is an X that is inside the S circle but outside the P circle. There is an X in the S circle, but we do not know whether it is inside or outside the P circle. Hence, the syllogistic form is invalid.

This is the “Barbara” syllogism. The conclusion states that the part of the S circle that is outside the P circle is empty. Inspection of the diagram reveals that this area is indeed empty. Thus, the syllogistic form is valid.

In this diagram no areas have been shaded, so there are two possible areas for each of the two X’s. The X from the first premise goes on the line (arc of the S circle) separating areas 1 and 2, and the X from the second premise goes on the line (arc of the
In each of the three diagrams the content of the first premise is represented correctly. The problem concerns placing the X from the second premise. In the first diagram the X is placed inside the S circle but outside both the M circle and the P circle. This diagram asserts: “At least one S is not an M and it is also not a P.” Clearly the diagram says more than the premise does, and so it is incorrect. In the second diagram the X is placed inside the S circle, outside the M circle, and inside the P circle. This diagram asserts: “At least one S is not an M, but it is a P.” Again, the diagram says more than the premise says, and so it is incorrect. In the third diagram, which is done correctly, the X is placed on the boundary between the two areas. This diagram asserts: “At least one S is not an M, and it may or may not be a P.” In other words, nothing at all is said about P, and so the diagram represents exactly the content of the second premise.

**Aristotelian Standpoint**

For the syllogistic forms tested thus far, we have adopted the Boolean standpoint, which does not recognize universal premises as having existential import. We now shift to the Aristotelian standpoint, where existential import can make a difference to validity. To test a syllogism from the Aristotelian standpoint, we follow basically the same procedure we followed in Section 4.6 to test immediate inferences:

1. Reduce the syllogism to its form and test it from the Boolean standpoint. If the form is valid, proceed no further. The syllogism is valid from both standpoints.
2. If the syllogistic form is invalid from the Boolean standpoint and has universal premises and a particular conclusion, then adopt the Aristotelian standpoint and
look to see if there is a Venn circle that is completely shaded except for one area. If there is, enter a circled X in that area and retest the form.

3. If the syllogistic form is conditionally valid, determine if the circled X represents something that exists. If it does, the condition is fulfilled, and the syllogism is valid from the Aristotelian standpoint.

In regard to step 2, if the diagram contains no Venn circle completely shaded except for one area, then the syllogism is invalid from the Aristotelian standpoint. However, if it does contain such a Venn circle and the syllogism has a particular conclusion, then we place a circled X in the one unshaded area. This circled X represents the temporary assumption that the Venn circle in question is not empty.

In regard to step 3, if the circled X does not represent something that exists, then the syllogism is invalid. As we will see in Section 5.3, such syllogisms commit the existential fallacy from the Aristotelian standpoint.

The table of conditionally valid syllogistic forms presented in Section 5.1 names nine forms that are valid from the Aristotelian standpoint if a certain condition is fulfilled. The following syllogism has one of those forms:

9. No fighter pilots are tank commanders.
   All fighter pilots are courageous individuals.
   Therefore, some courageous individuals are not tank commanders.

First, we replace the terms with letters and test the syllogism from the Boolean standpoint:

![Venn Diagram]

The conclusion asserts that there is an X that is inside the C circle but outside the T circle. Inspection of the diagram reveals no X's at all, so the syllogism is invalid from the Boolean standpoint. Proceeding to step 2, we adopt the Aristotelian standpoint and, noting that the conclusion is particular and that the F circle is all shaded except for one area, we enter a circled X in that area:
The diagram now indicates that the syllogism is conditionally valid, so we proceed to step 3 and determine whether the circled X represents something that actually exists. Since the circled X represents an \( F \), and since \( F \) stands for fighter pilots, the circled X does represent something that exists. Thus, the condition is fulfilled, and the syllogism is valid from the Aristotelian standpoint.

Here is another example:

10. All reptiles are scaly animals.  
   All currently living tyrannosaurs are reptiles.  
   Therefore, some currently living tyrannosaurs are scaly animals.

First we test the syllogism from the Boolean standpoint:

\[
\begin{align*}
\text{All} & \ R \ \text{are} \ S. \\
\text{All} & \ C \ \text{are} \ R. \\
\text{Some} & \ C \ \text{are} \ S.
\end{align*}
\]

The conclusion asserts that there is an X in the area where the C and S circles overlap. Since the diagram contains no X’s at all, the syllogism is invalid from the Boolean standpoint. Proceeding to step 2, we adopt the Aristotelian standpoint. Then, after noticing that the conclusion is particular and that the C circle is all shaded except for one area, we enter a circled X in that area:

\[
\begin{align*}
\text{All} & \ R \ \text{are} \ S. \\
\text{All} & \ C \ \text{are} \ R. \\
\text{Some} & \ C \ \text{are} \ S.
\end{align*}
\]

The diagram now indicates that the syllogism is conditionally valid, so we proceed to the third step and determine whether the circled X represents something that actually exists. Since the circled X represents a C, and C stands for currently living tyrannosaurs, the circled X does not represent something that actually exists. Thus, the condition is not fulfilled, and the syllogism is invalid. As we will see in the next section of this chapter, the syllogism commits the existential fallacy from the Aristotelian standpoint.

In determining whether the circled X stands for something that exists, we always look to the Venn circle that is all shaded except for one area. If the term corresponding to that circle denotes existing things, then the circled X represents one of those things.
In some diagrams, however, there may be two Venn circles that are all shaded except for one area, and each may contain a circled X in the unshaded area. In these cases we direct our attention only to the circled X needed to draw the conclusion. If that circled X stands for something that exists, the argument is valid; if not, it is invalid.

**Exercise 5.2**

I. Use Venn diagrams to determine whether the following standard-form categorical syllogisms are valid from the Boolean standpoint, valid from the Aristotelian standpoint, or invalid. Then, identify the mood and figure, and cross-check your answers with the tables of valid syllogisms found in Section 5.1.

★1. All corporations that overcharge their customers are unethical businesses. Some unethical businesses are investor-owned utilities. Therefore, some investor-owned utilities are corporations that overcharge their customers.

2. No AIDS victims are people who pose an immediate threat to the lives of others. Some kindergarten children are AIDS victims. Therefore, some kindergarten children are not people who pose an immediate threat to the lives of others.

3. No individuals truly concerned with the plight of suffering humanity are people motivated primarily by self-interest. All television evangelists are people motivated primarily by self-interest. Therefore, some television evangelists are not individuals truly concerned with the plight of suffering humanity.

★4. All high-fat diets are diets high in cholesterol. Some diets high in cholesterol are not healthy food programs. Therefore, some healthy food programs are not high-fat diets.

5. No engineering majors are candidates for nightly hookups. No candidates for nightly hookups are deeply emotional individuals. Therefore, no deeply emotional individuals are engineering majors.

6. All impulse buyers are consumers with credit cards. All shopaholics are impulse buyers. Therefore, all shopaholics are consumers with credit cards.

★7. No pediatricians are individuals who jeopardize the health of children. All faith healers are individuals who jeopardize the health of children. Therefore, no faith healers are pediatricians.

8. Some individuals prone to violence are not men who treat others humanely. Some police officers are individuals prone to violence. Therefore, some police officers are not men who treat others humanely.
9. Some ATM locations are places criminals lurk. 
   All places criminals lurk are places to avoid at night. 
   Therefore, some places to avoid at night are ATM locations.

10. No corporations that defraud the government are organizations the government should deal with. 
    Some defense contractors are not organizations the government should deal with. 
    Therefore, some defense contractors are not corporations that defraud the government.

11. All circular triangles are plane figures. 
    All circular triangles are three-sided figures. 
    Therefore, some three-sided figures are plane figures.

12. All supernovas are objects that emit massive amounts of energy. 
    All quasars are objects that emit massive amounts of energy. 
    Therefore, all quasars are supernovas.

13. No people who profit from the illegality of their activities are people who want their activities legalized. 
    All drug dealers are people who profit from the illegality of their activities. 
    Therefore, no drug dealers are people who want their activities legalized.

14. Some individuals who risk heart disease are people who will die young. 
    Some smokers are individuals who risk heart disease. 
    Therefore, some smokers are people who will die young.

15. Some communications satellites are rocket-launched failures. 
    All communications satellites are devices with antennas. 
    Therefore, some devices with antennas are rocket-launched failures.

16. All currently living dinosaurs are giant reptiles. 
    All giant reptiles are ectothermic animals. 
    Therefore, some ectothermic animals are currently living dinosaurs.

17. All survivalists are people who enjoy simulated war games. 
    No people who enjoy simulated war games are soldiers who have tasted the agony of real war. 
    Therefore, all soldiers who have tasted the agony of real war are survivalists.

18. No spurned lovers are Valentine’s Day fanatics. 
    Some moonstruck romantics are Valentine’s Day fanatics. 
    Therefore, some moonstruck romantics are not spurned lovers.

19. No theocracies are regimes open to change. 
    All theocracies are governments that rule by force. 
    Therefore, some governments that rule by force are not regimes open to change.

20. Some snowflakes are not uniform solids. 
    All snowflakes are six-pointed crystals. 
    Therefore, some six-pointed crystals are not uniform solids.
II. Use Venn diagrams to obtain the conclusion that is validly implied by each of the following sets of premises. If no conclusion can be validly drawn, write “no conclusion.”

1. No $P$ are $M$.  
   All $S$ are $M$.  
2. Some $P$ are not $M$.  
   Some $M$ are $S$.  
3. Some $M$ are $P$.  
   All $S$ are $M$.  
4. Some $M$ are not $P$.  
   All $M$ are $S$.  
5. Some $P$ are $M$.  
   All $M$ are $S$.  
6. No $M$ are $P$.  
   Some $S$ are not $M$.  
7. All $M$ are $P$.  
   All $S$ are $M$.  
8. All $P$ are $M$.  
   All $S$ are $M$.  
9. No $P$ are $M$.  
   Some $M$ are $S$.  
10. No $P$ are $M$.  
    No $M$ are $S$.

III. Answer “true” or “false” to the following statements.
1. In the use of Venn diagrams to test the validity of syllogisms, marks are sometimes entered in the diagram for the conclusion.
2. When an X is placed on the arc of a circle, it means that the X could be in either (or both) of the two areas that the arc separates.
3. If an X lies on the arc of a circle, the argument cannot be valid.
4. When representing a universal statement in a Venn diagram, one always shades two of the seven areas in the diagram (unless one of these areas is already shaded).
5. If a completed diagram contains two X’s, the argument cannot be valid.
6. If the conclusion asserts that a certain area is shaded, and inspection of the diagram reveals that only half that area is shaded, the argument is valid.
7. If the conclusion asserts that a certain area contains an X and inspection of the diagram reveals that only half an X appears in that area, the argument is valid.
8. If the conclusion is in the form “All $S$ are $P$,” and inspection of the diagram reveals that the part of the $S$ circle that is outside the $P$ circle is shaded, then the argument is valid.
9. If, in a completed diagram, three areas of a single circle are shaded, and placing a circled X in the one remaining area would make the conclusion true, then the argument is valid from the Aristotelian standpoint but not from the Boolean standpoint.
10. If, in a completed diagram, three areas of a single circle are shaded, but the argument is not valid from the Boolean standpoint, then it must be valid from the Aristotelian standpoint.
5.3 Rules and Fallacies

The idea that valid syllogisms conform to certain rules was first expressed by Aristotle. Many such rules are discussed in Aristotle’s own account, but logicians of today generally settle on five or six.* If any one of these rules is violated, a specific formal fallacy is committed and, accordingly, the syllogism is invalid. Conversely, if none of the rules is broken, the syllogism is valid. These rules may be used as a convenient cross-check against the method of Venn diagrams. We will first consider the rules as they apply from the Boolean standpoint, and then shift to the Aristotelian standpoint.

Boolean Standpoint

Of the five rules presented in this section, the first two depend on the concept of distribution, the second two on the concept of quality, and the last on the concept of quantity. In applying the first two rules, you may want to recall either of the two mnemonic devices presented in Chapter 4: “Unprepared Students Never Pass” and “Any Student Earning B’s Is Not On Probation.” These mnemonics help one remember that the four categorical propositions distribute their terms as follows:

<table>
<thead>
<tr>
<th>Statement type</th>
<th>Terms distributed</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>subject</td>
</tr>
<tr>
<td>E</td>
<td>subject, predicate</td>
</tr>
<tr>
<td>I</td>
<td>none</td>
</tr>
<tr>
<td>O</td>
<td>predicate</td>
</tr>
</tbody>
</table>

Here is the first rule.

Rule 1: The middle term must be distributed at least once.

Fallacy: Undistributed middle.

Example: All sharks are fish.
          All salmon are fish.
          All salmon are sharks.

In this standard-form categorical syllogism the middle term is “fish.” In both premises “fish” occurs as the predicate of an A proposition and therefore it is not distributed in either premise. Thus, the syllogism commits the fallacy of undistributed middle and is invalid. If the major premise were rewritten to read “All fish are sharks,” then “fish” would be distributed in that premise and the syllogism would be valid. But, of course, it would still be unsound because the rewritten premise would be false.

The logic behind Rule 1 may be explained by recounting how the middle term accomplishes its intended purpose, which is to provide a common ground between the

*Some texts include a rule stating that the three terms of a categorical syllogism must be used in the same sense throughout the argument. In this text this requirement is included as part of the definition of standard-form categorical syllogism and is subsequently incorporated into the definition of categorical syllogism. See Section 5.1.
subject and predicate terms of the conclusion. Let us designate the minor, major, and middle terms by the letters $S$, $P$, and $M$, respectively, and let us suppose that $M$ is distributed in the major premise. By definition, $P$ is related to the whole of the $M$ class. Then, when the $M$ class is related either in whole or in part to $S$, $S$ and $P$ necessarily become related. Analogous reasoning prevails if we suppose that $M$ is distributed in the minor premise. But if $M$ is undistributed in both premises, $S$ and $P$ may be related to different parts of the $M$ class, in which case there is no common ground for relating $S$ and $P$. This is exactly what happens in our fish example. The terms “salmon” and “sharks” are related to different parts of the fish class, so no common ground exists for relating them.

Rule 2: If a term is distributed in the conclusion, then it must be distributed in a premise.

Fallacies: Illicit major; illicit minor.

Examples:
- All horses are animals.
- Some dogs are not horses.
- All tigers are mammals.
- All mammals are animals.
- All animals are tigers.

In the first example the major term, “animals,” is distributed in the conclusion but not in the major premise, so the syllogism commits the fallacy of illicit major, or, more precisely, “illicit process of the major term.” In the second example the minor term, “animals,” is distributed in the conclusion but not in the minor premise. The second example therefore commits the fallacy of illicit minor, or “illicit process of the minor term.”

In applying this rule, one must always examine the conclusion first. If no terms are distributed in the conclusion, Rule 2 cannot be violated. If one or both terms in the conclusion are distributed, then the appropriate premise must be examined. If the term distributed in the conclusion is also distributed in the premise, then the rule is not violated. But, if the term is not distributed in the premise, the rule is violated and the syllogism is invalid. In applying Rule 2 (and also Rule 1), you may find it helpful to begin by marking all the distributed terms in the syllogism—either by circling them or by labeling them with a small letter “d.”

The logic behind Rule 2 is easy to understand. Let us once again designate the minor, major, and middle terms by the letters $S$, $P$, and $M$, respectively, and let us suppose that a certain syllogism commits the fallacy of illicit major. The conclusion of that syllogism then makes an assertion about every member of the $P$ class, but the major premise makes an assertion about only some members of the $P$ class. Because the minor premise, by itself, says nothing at all about the $P$ class, the conclusion clearly contains information not contained in the premises, and the syllogism is therefore invalid. Analogous reasoning applies to the fallacy of illicit minor.

Rule 2 becomes intuitively plausible when it is recognized that distribution is a positive attribute. Granting this, an argument that has a term distributed in the conclusion...
but not in the premises has *more* in the conclusion than it does in the premises and is therefore invalid. Of course, it is always permissible to have more in a premise than appears in the conclusion, so it is perfectly all right for a term to be distributed in a premise but not in the conclusion.

**Rule 3: Two negative premises are not allowed.**

*Fallacy:* **Exclusive premises.**

*Example:*  
- No fish are mammals.  
- Some dogs are not fish.  
- Some dogs are not mammals.

This syllogism may be seen as invalid because it has true premises and a false conclusion. The defect stems from the fact that it has two negative premises.

On reflection, Rule 3 should be fairly obvious. Let $S$, $P$, and $M$ once again designate the minor, major, and middle terms. Now, if the $P$ class and the $M$ class are separate either wholly or partially, and the $S$ class and the $M$ class are separate either wholly or partially, nothing is said about the relation between the $S$ class and the $P$ class. These two classes may be either distinct or identical in whole or in part. Venn diagrams may be used effectively to illustrate the fact that no conclusion can be validly drawn from two negative premises.

**Rule 4: A negative premise requires a negative conclusion, and a negative conclusion requires a negative premise.**

*Fallacy:* **Drawing an affirmative conclusion from a negative premise.**  
*or*  
**Drawing a negative conclusion from affirmative premises.**

*Examples:*  
- All crows are birds.  
- Some wolves are not crows.  
- Some wolves are birds.  
- All triangles are three-sided polygons.  
- All three-sided polygons are three-sided polygons.  
- Some three-sided polygons are not triangles.

These arguments may be seen as invalid because each has true premises and a false conclusion. The first draws an affirmative conclusion from a negative premise, and the second draws a negative conclusion from affirmative premises.

The logic behind Rule 4 may be seen as follows. If $S$, $P$, and $M$ once again designate the minor, major, and middle terms, an affirmative conclusion always states that the $S$ class is contained either wholly or partially in the $P$ class. The only way that such a conclusion can follow is if the $S$ class is contained either wholly or partially in the $M$ class, and the $M$ class wholly in the $P$ class. In other words, it follows only when both premises are affirmative. But if, for example, the $S$ class is contained either wholly or partially in the $M$ class, and the $M$ class is separate either wholly or partially from the $P$ class, such a conclusion will never follow. Thus, an affirmative conclusion cannot be drawn from negative premises.
Conversely, a negative conclusion asserts that the $S$ class is separate either wholly or partially from the $P$ class. But if both premises are affirmative, they assert class inclusion rather than separation. Thus, a negative conclusion cannot be drawn from affirmative premises.

As a result of the interaction of these first four rules, it turns out that no valid syllogism can have two particular premises. This result is convenient to keep in mind, because it allows us to identify as invalid any standard-form syllogism in which both premises start with “some.” Because it is logically derivable from the first four rules, a separate rule to this effect is not given here.

**Rule 5: If both premises are universal, the conclusion cannot be particular.**

*Fallacy:* **Existential fallacy.**

*Example:* 

- All mammals are animals.
- All tigers are mammals.
- Some tigers are animals.

The example has two universal premises and a particular conclusion, so it violates Rule 5. It commits the existential fallacy from the Boolean standpoint. The reason the syllogism is invalid from the Boolean standpoint is that the conclusion asserts that tigers exist, whereas the premises make no such assertion. From the Boolean standpoint, universal premises have no existential import.

In applying Rule 5, keep in mind that the existential fallacy is a fallacy that occurs when a syllogism is invalid merely because the premises lack existential import. Thus, if a syllogism is invalid for some other reason (that is, if it commits some other fallacy), it does not commit the existential fallacy. Hence, before deciding that a syllogism breaks Rule 5, make certain that no other rule is violated. If a syllogism does break one of the other four rules, Rule 5 does not apply.

**Aristotelian Standpoint**

Any categorical syllogism that breaks one of the first four rules is invalid from the Aristotelian standpoint. However, if a syllogism breaks only Rule 5, it is valid from the Aristotelian standpoint on condition that the critical term denotes at least one existing thing. (The critical term is the term listed in the farthest right-hand column of the table of conditionally valid syllogistic forms presented in Section 5.1.) In the example given in connection with Rule 5, the critical term is “tigers,” and the syllogism breaks no other rules, so it is valid from the Aristotelian standpoint. The conclusion asserts that tigers exist, and from the Aristotelian standpoint the premises imply their existence. On the other hand, consider the following example:

- All mammals are animals.
- All unicorns are mammals.
- Some unicorns are animals.

In this example, the critical term is “unicorns.” Since unicorns do not exist, the premises have no existential import from the Aristotelian standpoint. Thus, the syllogism
The clear explanations and well chosen examples make the content approachable and help retain concepts and techniques.

Chapter 5  Categorical Syllogisms

is invalid from the Aristotelian standpoint, and it commits the existential fallacy from that standpoint. Of course, it also commits the existential fallacy from the Boolean standpoint.

In addition to consulting the table of conditionally valid forms, one way of identifying the critical term is to draw a Venn diagram. The critical term is the one that corresponds to the circle that is all shaded except for one area. In the case of two such circles, it is the one that corresponds to the Venn circle containing the circled X on which the conclusion depends. Another way of identifying the critical term is through examination of the distributed terms in the syllogism. The critical term is the one that is superfluously distributed. In other words, it is the term that, in the premises, is distributed in more occurrences than is necessary for the syllogism to obey all the rules. Here are three examples:

<table>
<thead>
<tr>
<th>M are P.</th>
<th>M are P.</th>
<th>P are M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>S are M.</td>
<td>S are M.</td>
<td>M are S.</td>
</tr>
<tr>
<td>S are P.</td>
<td>S are not P.</td>
<td>S are P.</td>
</tr>
</tbody>
</table>

The distributed terms are tagged with a small “d.” In the first syllogism, M must be distributed to satisfy Rule 1, but S, in the second premise, need not be distributed to satisfy any rule. Thus, by the superfluous distribution rule, S is the term that must denote actually existing things for the syllogism to be valid from the Aristotelian standpoint. In the second syllogism, P must be distributed in the first premise to satisfy Rule 2, and M must be distributed once to satisfy Rule 1; but M is distributed twice. Thus, M is the term that must denote existing things for the syllogism to be valid from the Aristotelian standpoint. In the third syllogism, M must be distributed to satisfy Rule 1, but P need not be distributed to satisfy any rule. Thus, in this syllogism, P is the critical term.

You may recall that the existential fallacy from the Boolean standpoint first appeared in Section 4.3, where it arose in connection with the modern square of opposition. Also, the existential fallacy from the Aristotelian standpoint first appeared in Section 4.5, where it arose in connection with the traditional square of opposition. The two versions of the existential fallacy that appear in connection with Rule 5 stem from the same mistake as it relates to categorical syllogisms.

Finally, if you turn to the table of conditionally valid forms in Section 5.1, you will see that all of the forms listed there break Rule 5. All of them have universal premises and a particular conclusion, and they break no other rule. Thus, all of them commit the existential fallacy from the Boolean standpoint. But if the Aristotelian standpoint is adopted and the critical term refers to something that does not exist, the Aristotelian standpoint gives exactly the same results as the Boolean. (See Section 4.3.) Thus, under these conditions, all of the syllogistic forms in the conditionally valid table commit the existential fallacy from the Aristotelian standpoint as well.

Proving the Rules

The foregoing discussion has shown that if a syllogism breaks any one of the five rules, it cannot be valid from the Boolean standpoint. Thus, we have shown that each of the rules is a necessary condition for validity. The question remains, however, whether a
syllogism’s breaking none of the rules is a sufficient condition for validity. In other words, does the fact that a syllogism breaks none of the rules guarantee its validity? The answer to this question is “yes,” but unfortunately there appears to be no quick method for proving this fact. Therefore, if you are willing to take your instructor’s word for it, you may stop reading this section now and proceed to the exercises. The proof that follows is somewhat tedious, and it proceeds by considering four classes of syllogisms having A, E, I, and O propositions for their conclusions.

Let us first suppose we are given a valid syllogism having an A proposition for its conclusion. Once again, suppose that P, S, and M designate the major, minor, and middle terms, respectively. Then, by Rules 1 and 2, both M and S are distributed in the premises. Further, by Rule 4, both premises are affirmative. Now, since I propositions distribute neither term, and A propositions distribute only one term, both premises must be A propositions, and S must be distributed in one and M in the other. Accordingly, the premises are “All S are M” and “All M are P.” If we now combine these premises with the conclusion, “All S are P,” we can determine by simple reasoning or a Venn diagram that the syllogism is valid. Note that only Rules 1, 2, and 4 were used in producing this first step in our proof, but the resulting syllogism obeys the unused rules as well. A similar process applies to the steps that follow.

Next, we consider a syllogism having an E proposition for its conclusion. By Rules 1 and 2, all three terms are distributed in the premises, and by Rules 3 and 4, one premise is negative and the other affirmative. Because three terms are distributed in the premises and there are only two premises, one of the premises must distribute two terms. Accordingly, this premise must be an E proposition. Furthermore, the other premise, which is affirmative and which distributes the third term, must be an A proposition. From this we conclude that there are four possible sets of premises: “All S are M” and “No M are P” (or its converse), and “All P are M” and “No M are S” (or its converse). Since converting an E proposition has no effect on validity, we may ignore the converse of these propositions. If we now combine the two given sets of premises with the conclusion, “No S are P,” simple reasoning or a pair of Venn diagrams will establish the validity of the two resulting syllogisms.

Next, consider a syllogism having an I proposition for its conclusion. By Rule 1, M is distributed in at least one premise, and by Rule 4, both premises are affirmative. Further, by Rule 5, both premises cannot be universal. Thus, at least one premise is an I proposition. However, since the other premise distributes a term, that premise must be an A proposition. Accordingly, the four possible sets of premises are “All M are S” and “Some M are P” (or its converse), and “All P are M” and “Some M are S” (or its converse). Again, since converting an I proposition has no effect on validity, we may ignore the converse of these propositions. Then if we combine the two given pairs of premises with the conclusion, “Some S are P,” simple reasoning or a pair of Venn diagrams will establish the validity of the two resulting syllogisms.

Last, we consider a syllogism having an O proposition for its conclusion. By Rules 1 and 2, both M and P are distributed in the premises. Also, by Rules 3 and 4, one premise is negative and the other affirmative, and by Rule 5, both premises cannot be universal. However, both premises cannot be particular (I and O), because then only one term would be distributed. Therefore, the premises are either A and O or
E and I. In regard to the first of these alternatives, either \( M \) is the subject of the A statement and \( P \) is the predicate of the O, or \( P \) is the subject of the A statement and \( M \) is the predicate of the O. This gives the premises as “All \( M \) are \( S \)” and “Some \( M \) are not \( P \),” and “All \( P \) are \( M \)” and “Some \( S \) are not \( M \).” When these pairs of premises are combined with the conclusion, “Some \( S \) are not \( P \),” simple reasoning or a pair of Venn diagrams will establish the validity of the two resulting syllogisms. Finally, considering the other alternative (E and I), the resulting four sets of premises are “No \( M \) are \( P \)” (or its converse) and “Some \( M \) are \( S \)” (or its converse). Again ignoring the converted propositions, simple reasoning or a Venn diagram will establish the validity of the single resulting syllogism.

This procedure proves that the five rules collectively provide a sufficient condition for the validity of any syllogism from the Boolean standpoint. Since eight distinct inferences or Venn diagrams were needed to accomplish it, this shows that there are really only eight significantly distinct syllogisms that are valid from the Boolean standpoint. The other seven are variations of these that result from converting one of the premises. For syllogisms having particular conclusions and universal premises about existing things, an analogous procedure can be used to prove that the first four rules collectively provide a sufficient condition for the validity of any syllogism from the Aristotelian standpoint.

Exercise 5.3

I. Reconstruct the following syllogistic forms and use the five rules for syllogisms to determine if they are valid from the Boolean standpoint, conditionally valid from the Aristotelian standpoint, or invalid. For those that are conditionally valid, identify the condition that must be fulfilled. For those that are invalid from either the Boolean or Aristotelian standpoint, name the fallacy or fallacies committed. Check your answers by constructing a Venn diagram for each.

1. AAA-3  
2. IAI-2  
3. EIO-1  
4. AAI-2  
5. IEO-1  
6. EOO-4  
7. EAA-1  
8. AII-3  
9. AAI-4  
10. IAO-3

11. AII-2  
12. AIO-3  
13. AEE-4  
14. EAE-4  
15. EAO-3  
16. EEE-1  
17. EAE-1  
18. OAI-3  
19. AOO-2  
20. EAO-1
II. Use the five rules to determine whether the following standard-form syllogisms are valid from the Boolean standpoint, conditionally valid from the Aristotelian standpoint, or invalid. For those that are invalid from either the Boolean or Aristotelian standpoint, name the fallacy or fallacies committed. Check your answer by constructing a Venn diagram for each.

1. Some nebulas are clouds of gas.
   Some clouds of gas are objects invisible to the naked eye.
   Therefore, some objects invisible to the naked eye are nebulas.

2. No individuals sensitive to the difference between right and wrong are people who measure talent and success in terms of wealth.
   All corporate takeover experts are people who measure talent and success in terms of wealth.
   Therefore, no corporate takeover experts are individuals sensitive to the difference between right and wrong.

3. No endangered species are creatures loved by the timber industry.
   All spotted owls are endangered species.
   Therefore, some spotted owls are not creatures loved by the timber industry.

4. Some cases of affirmative action are not measures justified by past discrimination.
   No cases of affirmative action are illegal practices.
   Therefore, some illegal practices are not measures justified by past discrimination.

5. All transparent metals are good conductors of heat.
   All transparent metals are good conductors of electricity.
   Therefore, some good conductors of electricity are good conductors of heat.

6. All members of the National Rifle Association are people opposed to gun control.
   All members of the National Rifle Association are law-abiding citizens.
   Therefore, all law-abiding citizens are people opposed to gun control.

7. No searches based on probable cause are violations of Fourth Amendment rights.
   Some warrantless searches are violations of Fourth Amendment rights.
   Therefore, some warrantless searches are not searches based on probable cause.

8. All war zones are places where abuse of discretion is rampant.
   Some places where abuse of discretion is rampant are international borders.
   Therefore, some international borders are war zones.

9. All inside traders are people subject to prosecution.
   Some executives with privileged information are not people subject to prosecution.
   Therefore, some executives with privileged information are inside traders.

10. All successful flirts are masters at eye contact.
    All masters at eye contact are people genuinely interested in others.
    Therefore, some people genuinely interested in others are successful flirts.
III. Answer “true” or “false” to the following statements.

1. If a categorical syllogism violates one of the first four rules, it may still be valid.
2. If a valid syllogism has an E statement as its conclusion, then both the major and minor terms must be distributed in the premises.
3. If a syllogism has two I statements as premises, then it is invalid.
4. If a syllogism has an E and an O statement as premises, then no conclusion follows validly.
5. If a syllogism has an I statement as its conclusion, then Rule 2 cannot be violated.
6. If a valid syllogism has an O statement as its conclusion, then its premises can be an A and an I statement.
7. If a valid syllogism has an E statement as a premise, then its conclusion can be an A statement.
8. If a syllogism breaks only Rule 5 and its three terms are “dogs,” “cats,” and “animals,” then the syllogism is valid from the Boolean standpoint.
9. If a syllogism breaks only Rule 5 and its three terms are “dogs,” “cats,” and “animals,” then the syllogism is valid from the Aristotelian standpoint.
10. If a syllogism breaks only Rule 5 and its three terms are “elves,” “trolls,” and “gnomes,” then the syllogism is valid from the Aristotelian standpoint.

5.4 Reducing the Number of Terms

Categorical syllogisms, as they occur in ordinary spoken and written expression, are seldom phrased according to the precise norms of the standard-form syllogism. Sometimes quantifiers, premises, or conclusions are left unexpressed, chains of syllogisms are strung together into single arguments, and terms are mixed together with their negations in a single argument. The final four sections of this chapter are concerned with developing techniques for reworking such arguments in order to render them testable by Venn diagrams or by the rules for syllogisms.

In this section we consider arguments that contain more than three terms but that can be modified to reduce the number of terms to three. Consider the following:

All photographers are non-writers.
Some editors are writers.
Therefore, some non-photographers are not non-editors.

This syllogism is clearly not in standard form because it has six terms: “photographers,” “editors,” “writers,” “non-photographers,” “non-editors,” and “non-writers.” But because three of the terms are complements of the other three, the number of
terms can be reduced to a total of three, each used twice in distinct propositions. To accomplish the reduction, we can use the three operations of conversion, obversion, and contraposition discussed in Chapter 4. But, of course, since the reworked syllogism must be equivalent in meaning to the original one, we must use these operations only on the kinds of statements for which they yield logically equivalent results. That is, we must use conversion only on E and I statements and contraposition only on A and O statements. Obversion yields logically equivalent results for all four kinds of categorical statements.

Let us rewrite our six-term argument using letters to represent the terms, and then obvert the first premise and contrapose the conclusion in order to eliminate the negated letters:

<table>
<thead>
<tr>
<th>Symbolized argument</th>
<th>Reduced argument</th>
</tr>
</thead>
<tbody>
<tr>
<td>All P are non-W.</td>
<td>No P are W.</td>
</tr>
<tr>
<td>Some E are W.</td>
<td>Some E are W.</td>
</tr>
<tr>
<td>Some non-P are non-E.</td>
<td>Some E are not P.</td>
</tr>
</tbody>
</table>

Because the first premise of the original argument is an A statement and the conclusion an O statement, and because the operations performed on these statements yield logically equivalent results, the reduced argument is equivalent in meaning to the original argument. The reduced argument is in standard syllogistic form and may be evaluated either with a Venn diagram or by the five rules for syllogisms. The application of these methods indicates that the reduced argument is valid. We conclude, therefore, that the original argument is also valid.

It is not necessary to eliminate the negated terms in order to reduce the number of terms. It is equally effective to convert certain nonnegated terms into negated ones. Thus, instead of obverting the first premise of the example argument and contraposing the conclusion, we could have contraposed the first premise and converted and then obverted the second premise. The operation is performed as follows:

<table>
<thead>
<tr>
<th>Symbolized argument</th>
<th>Reduced argument</th>
</tr>
</thead>
<tbody>
<tr>
<td>All P are non-W.</td>
<td>All W are non-P.</td>
</tr>
<tr>
<td>Some E are W.</td>
<td>Some W are not non-E.</td>
</tr>
<tr>
<td>Some non-P are non-E.</td>
<td>Some non-P are not non-E.</td>
</tr>
</tbody>
</table>

The reduced argument is once again equivalent to the original one, but now we must reverse the order of the premises to put the syllogism into standard form:

\[
\begin{align*}
\text{Some W are not non-E.} \\
\text{All W are non-P.} \\
\text{Some non-P are not non-E.}
\end{align*}
\]

When tested with a Venn diagram or by means of the five rules, this argument will, of course, also be found valid, and so the original argument is valid. When using a Venn diagram, no unusual method is needed; the diagram is simply lettered with the three terms “W,” “non-E,” and “non-P.”

The most important point to remember in reducing the number of terms is that conversion and contraposition must never be used on statements for which they yield
As a child, Saul Kripke demonstrated prodigious intellectual abilities. By the age of ten, he had read all the plays of Shakespeare, and he discovered algebra, which he said he could have invented on his own. By fourteen, he had mastered geometry and calculus and became deeply involved in philosophy. At seventeen, he wrote a paper, published in the prestigious Journal of Symbolic Logic, that introduced a completeness theorem for modal logic. Legend has it that when this paper reached the attention of the Harvard mathematics department, someone there invited him to apply for a teaching position. He replied, “My mother said that I should finish high school and go to college first.” Today, Kripke is considered by many to be the world’s greatest living philosopher and logician.

Saul Kripke was born the son of a rabbi in Bay Shore, New York, in 1940. He attended public grade school and high school in Omaha, Nebraska, and then Harvard University where, during his sophomore year, he taught a graduate level course at M.I.T. In 1962 he graduated summa cum laude with a bachelor’s degree in mathematics. After that, instead of going to graduate school, he simply began teaching—first at Harvard, then Rockefeller University, then Princeton University, and finally CUNY Graduate Center. He has received honorary degrees from several universities, and in 2001 he received the Schock Prize (comparable to the Nobel Prize) in Logic and Philosophy. Kripke is universally hailed for his work in modal logic where, in addition to proving its formal completeness, he created a semantics, now called Kripke semantics, in which a proposition is said to be necessarily true when it holds in all possible worlds and possibly true when it holds in some possible world. Also, his book Naming and Necessity made groundbreaking contributions to the philosophy of language by introducing a new theory of reference for proper names.

undetermined results. That is, conversion must never be used on $A$ and $O$ statements, and contraposition must never be used on $E$ and $I$ statements. The operations that are allowed are summarized as follows:

<table>
<thead>
<tr>
<th>Conversion:</th>
<th>No $A$ are $B$.</th>
<th>No $B$ are $A$.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Some $A$ are $B$.</td>
<td>Some $B$ are $A$.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Obversion:</th>
<th>All $A$ are $B$.</th>
<th>No $A$ are non-$B$.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No $A$ are $B$.</td>
<td>All $A$ are non-$B$.</td>
</tr>
<tr>
<td></td>
<td>Some $A$ are $B$.</td>
<td>Some $A$ are not non-$B$.</td>
</tr>
<tr>
<td></td>
<td>Some $A$ are not $B$.</td>
<td>Some $A$ are non-$B$.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contraposition:</th>
<th>All $A$ are $B$.</th>
<th>All non-$B$ are non-$A$.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Some $A$ are not $B$.</td>
<td>Some non-$B$ are not non-$A$.</td>
</tr>
</tbody>
</table>
Exercise 5.4

Rewrite the following arguments using letters to represent the terms, reduce the number of terms, and put the arguments into standard form. Then test the new forms with Venn diagrams or by means of the five rules for syllogisms to determine the validity or invalidity of the original arguments.

★ 1. Some intelligible statements are true statements, because all unintelligible statements are meaningless statements and some false statements are meaningful statements.

2. Some people who do not regret their crimes are convicted murderers, so some convicted murderers are people insusceptible of being reformed, since all people susceptible of being reformed are people who regret their crimes.

3. All Peace Corps volunteers are people who have witnessed poverty and desolation, and all people insensitive to human need are people who have failed to witness poverty and desolation. Thus, all Peace Corps volunteers are people sensitive to human need.

★ 4. Some unintentional killings are not punishable offenses, inasmuch as all cases of self-defense are unpunishable offenses, and some intentional killings are cases of self-defense.

5. All aircraft that disintegrate in flight are unsafe planes. Therefore, no poorly maintained aircraft are safe planes, because all well-maintained aircraft are aircraft that remain intact in flight.

6. No objects that sink in water are chunks of ice, and no objects that float in water are things at least as dense as water. Accordingly, all chunks of ice are things less dense than water.

★ 7. Some proposed flights to Mars are inexpensive ventures, because all unmanned space missions are inexpensive ventures, and some proposed flights to Mars are not manned space missions.

8. All schools driven by careerism are institutions that do not emphasize liberal arts. It follows that some universities are not institutions that emphasize liberal arts, for some schools that are not driven by careerism are universities.

9. No cases of AIDS are infections easily curable by drugs, since all diseases that infect the brain are infections not easily curable by drugs, and all diseases that do not infect the brain are cases other than AIDS.

★ 10. Some foreign emissaries are people without diplomatic immunity, so some people invulnerable to arrest and prosecution are foreign emissaries, because no people with diplomatic immunity are people vulnerable to arrest and prosecution.
Ordinary Language Arguments

Many arguments that are not standard-form categorical syllogisms as written can be translated into standard-form syllogisms. In doing so we often use techniques developed in the last section of Chapter 4—namely, inserting quantifiers, modifying subject and predicate terms, and introducing copulas. The goal, of course, is to produce an argument consisting of three standard-form categorical propositions that contain a total of three different terms, each of which occurs twice in distinct propositions. Once translated, the argument can be tested by means of a Venn diagram or the rules for syllogisms.

Since the task of translating arguments into standard-form syllogisms involves not only converting the component statements into standard form but adjusting these statements one to another so that their terms occur in matched pairs, a certain amount of practice may be required before it can be done with facility. In reducing the terms to three matched pairs it is often helpful to identify some factor common to two or all three propositions and to express this common factor through the strategic use of parameters. For example, if all three statements are about people, the term “people” or “people identical to” might be used; or if they are about times or places, the term “times” or “times identical to” or the term “places” or “places identical to” might be used. Here is an example:

Whenever people put off marriage until they are older, the divorce rate decreases.
Today, people are putting off marriage until they are older. Therefore, the divorce rate is decreasing today.

The temporal adverbs “whenever” and “today” suggest that “times” should be used as the common factor. Following this suggestion, we have this:

All times people put off marriage until they are older are times the divorce rate decreases. All present times are times people put off marriage until they are older. Therefore, all present times are times the divorce rate decreases.

This is a standard-form categorical syllogism. Notice that each of the three terms is matched with an exact duplicate in a different proposition. To obtain such a match, it is sometimes necessary to alter the wording of the original statement just slightly. Now if we adopt the convention

\[ M = \text{times people put off marriage until they are older} \]
\[ D = \text{times the divorce rate decreases} \]
\[ P = \text{present times} \]

the syllogism may be symbolized as follows:

All \( M \) are \( D \).
All \( P \) are \( M \).
All \( P \) are \( D \).

This is the so-called “Barbara” syllogism and is, of course, valid. Here is another example:
Boeing must be a manufacturer because it hires riveters, and any company that hires riveters is a manufacturer.

For this argument the parameter “companies” suggests itself:

All companies identical to Boeing are manufacturers, because all companies identical to Boeing are companies that hire riveters, and all companies that hire riveters are manufacturers.

The first statement, of course, is the conclusion. When the syllogism is written in standard form, it will be seen that it has, like the previous syllogism, the form AAA-1.

Here is another example:

If a piece of evidence is trustworthy, then it should be admissible in court. Polygraph tests are not trustworthy. Therefore, they should not be admissible in court.

To translate this argument, using a single common factor is not necessary:

All trustworthy pieces of evidence are pieces of evidence that should be admissible in court. No polygraph tests are trustworthy pieces of evidence. Therefore, no polygraph tests are pieces of evidence that should be admissible in court.

This syllogism commits the fallacy of illicit major and is therefore invalid.

As was mentioned in Section 4.7, arguments containing an exceptive proposition must be handled in a special way. Let us consider one that contains an exceptive proposition as a premise:

All of the jeans except the Levi’s are on sale. Therefore, since the Calvin Klein jeans are not Levi’s, they must be on sale.

The first premise is translated as two conjoined categorical propositions: “No Levi’s are jeans on sale,” and “All jeans that are not Levi’s are jeans on sale.” These give rise to two syllogisms:

No Levi’s are jeans on sale.
No Calvin Klein jeans are Levi’s.
Therefore, all Calvin Klein jeans are jeans on sale.

All jeans that are not Levi’s are jeans on sale.
No Calvin Klein jeans are Levi’s.
Therefore, all Calvin Klein jeans are jeans on sale.

The first syllogism, which is in standard form, is invalid because it has two negative premises. The second one, on the other hand, is not in standard form, because it has four terms. If the second premise is obverted, so that it reads “All Calvin Klein jeans are jeans that are not Levi’s,” the syllogism becomes an AAA-1 standard-form syllogism, which is valid.

Each of these two syllogisms may be viewed as a pathway in which the conclusion of the original argument might follow necessarily from the premises. Since it does follow via the second syllogism, the original argument is valid. If both of the resulting syllogisms turned out to be invalid, the original argument would be invalid.
Exercise 5.5

Translate the following arguments into standard-form categorical syllogisms, then use Venn diagrams or the rules for syllogisms to determine whether each is valid or invalid. See Section 4.7 for help with the translation.

1. Physicists are the only scientists who theorize about the nature of time, and Stephen Hawking certainly does that. Therefore, Stephen Hawking must be a physicist.

2. Whenever suicide rates decline, we can infer that people’s lives are better adjusted. Accordingly, since suicide rates have been declining in recent years, we can infer that people’s lives have been better adjusted in recent years.

3. Environmentalists purchase only fuel-efficient cars. Hence, Hummers must not be fuel efficient, since environmentalists do not purchase them.

4. Whoever wrote the Declaration of Independence had a big impact on civilization, and Thomas Jefferson certainly had that. Therefore, Thomas Jefferson wrote the Declaration of Independence.

5. There are public schools that teach secular humanism. Therefore, since secular humanism is a religion, there are public schools that teach religion.

6. Any city that has excellent art museums is a tourist destination. Therefore, Paris is a tourist destination, because it has excellent art museums.

7. Shania Twain sings what she wants. Hence, since Shania sings country songs, it follows that she must want to sing country songs.

8. Not all interest expenses are tax deductible. Home mortgage payments are interest expenses. Thus, they are not tax deductible.

9. If a marriage is based on a meshing of neuroses, it allows little room for growth. If a marriage allows little room for growth, it is bound to fail. Therefore, if a marriage is based on a meshing of neuroses, it is bound to fail.

10. TV viewers cannot receive scrambled signals unless they have a decoder. Whoever receives digital satellite signals receives scrambled signals. Therefore, whoever receives digital satellite signals has a decoder.

11. Wherever icebergs are present, threats to shipping exist. Icebergs are not present in the South Pacific. Hence, there are no threats to shipping in the South Pacific.

12. According to surveys, there are college students who think that Africa is in North America. But anyone who thinks that has no knowledge of geography. It follows that there are college students who have no knowledge of geography.

13. Diseases carried by recessive genes can be inherited by offspring of two carriers. Thus, since cystic fibrosis is a disease carried by recessive genes, it can be inherited by offspring of two carriers.
14. All of the movies except the chick flicks were exciting. Hence, the action films were exciting, because none of them is a chick flick.

15. Autistic children are occasionally helped by aversive therapy. But aversive therapy is sometimes inhumane. Thus, autistic children are sometimes helped by inhumane therapy.

5.6 Enthymemes

An enthymeme is an argument that is expressible as a categorical syllogism but that is missing a premise or a conclusion. Examples:

The corporate income tax should be abolished; it encourages waste and high prices.
Animals that are loved by someone should not be sold to a medical laboratory, and lost pets are certainly loved by someone.

The first enthymeme is missing the premise “Whatever encourages waste and high prices should be abolished,” and the second is missing the conclusion “Lost pets should not be sold to a medical laboratory.”

Enthymemes occur frequently in ordinary spoken and written English for several reasons. Sometimes it is simply boring to express every statement in an argument. The listener or reader’s intelligence is called into play when he or she is required to supply a missing statement, thereby sustaining his or her interest. On other occasions the arguer may want to slip an invalid or unsound argument past an unwary listener or reader, and this aim may be facilitated by leaving a premise or conclusion out of the picture.

Many enthymemes are easy to convert into syllogisms. The reader or listener must first determine what is missing, whether premise or conclusion, and then introduce the missing statement with the aim of converting the enthymeme into a good argument. Attention to indicator words will often provide the clue as to the nature of the missing statement, but a little practice can render this task virtually automatic. The missing statement need not be expressed in categorical form; expressing it in the general context of the other statements is sufficient and is often the easier alternative. Once this is done, the entire argument may be translated into categorical form and then tested with a Venn diagram or by the rules for syllogisms. Example:

Venus completes its orbit in less time than the Earth, because Venus is closer to the sun.

*Missing premise:* Any planet closer to the sun completes its orbit in less time than the Earth.

Translating this argument into categorical form, we have

All planets closer to the sun are planets that complete their orbit in less time than the Earth.
All planets identical to Venus are planets closer to the sun.
All planets identical to Venus are planets that complete their orbit in less time than the Earth.

This syllogism is valid (and sound).
Any enthymeme (such as the one about Venus) that contains an indicator word is missing a premise. This may be seen as follows. If an enthymeme contains a conclusion indicator, then the conclusion follows it, which means that the missing statement is a premise. On the other hand, if the enthymeme contains a premise indicator, then the conclusion precedes it, which means, again, that the missing statement is a premise.

If, however, an enthymeme contains no indicator words at all (such as the two enthymemes at the beginning of this section), then the missing statement could be either a premise or a conclusion. If the two given statements are joined by a word such as “and,” “but,” “moreover,” or some similar conjunction, the missing statement is usually a conclusion. If not, the first statement is usually the conclusion, and the missing statement is a premise. To test this latter alternative, it may help to mentally insert the word “because” between the two statements. If this insertion makes sense, the missing statement is a premise.

After the nature of the missing statement has been determined, the next task is to write it out. To do so, one must first identify its terms. This can be done by taking account of the terms that are given. Two of the terms in the given statements will match up with each other. Once this pair of terms is found, attention should be focused on the other two terms. These are the ones that will be used to form the missing statement. In constructing the missing statement, attention to the rules for syllogisms may be helpful (if the resulting syllogism is to be valid). For example, if the missing statement is a conclusion and one of the given premises is negative, the missing conclusion must be negative. Or if the missing statement is a premise and the stated conclusion is universal, the missing premise must be universal.

The enthymemes that we have considered thus far have been fairly straightforward. The kinds of enthymemes that occur in letters to the editor of magazines and newspapers often require a bit more creativity to convert into syllogisms. Consider the following:

The motorcycle has served as basic transportation for the poor for decades. It deserves to be celebrated.

(William B. Fankboner)

The conclusion is the last statement, and the missing premise is that any vehicle that has served as basic transportation for the poor for decades deserves to be celebrated. The enthymeme may be written as a standard-form syllogism as follows:

All vehicles that have served as basic transportation for the poor for decades are vehicles that deserve to be celebrated.

All vehicles identical to the motorcycle are vehicles that have served as basic transportation for the poor for decades.

Therefore, all vehicles identical to the motorcycle are vehicles that deserve to be celebrated.

The syllogism is valid and arguably sound. Here is another example:

I know several doctors who smoke. In a step toward my own health, I will no longer be their patient. It has occurred to me that if they care so little about their own health, how can they possibly care about mine?

(Joan Boyer)
In this argument the author draws three connections: the connection between doctors’ smoking and doctors’ caring about their own health, between doctors’ caring about their own health and doctors’ caring about the author’s health, and between doctors’ caring about the author’s health and doctors who will have the author as a patient. Two arguments are needed to express these connections:

All doctors who smoke are doctors who do not care about their own health.
All doctors who do not care about their own health are doctors who do not care about my health.
Therefore, all doctors who smoke are doctors who do not care about my health.

And,

All doctors who smoke are doctors who do not care about my health.
All doctors who do not care about my health are doctors who will not have me as a patient.
Therefore, all doctors who smoke are doctors who will not have me as a patient.

Notice that the conclusion of the first argument becomes a premise in the second argument. To put these arguments into final standard form the order of the premises must be reversed. Both arguments are valid, but probably not sound.

**Exercise 5.6**

In this set of exercises, students are taken step by step through the techniques needed to solve the exercises that follow.

I. In the following enthymemes determine whether the missing statement is a premise or a conclusion. Then supply the missing statement, attempting whenever possible to convert the enthymeme into a valid argument. The missing statement need not be expressed as a standard-form categorical proposition.

1. Some police chiefs undermine the evenhanded enforcement of the law, because anyone who fixes parking tickets does that.
2. Any form of cheating deserves to be punished, and plagiarism is a form of cheating.
3. Carrie Underwood is a talented singer. After all, she’s won several Grammy awards.
4. A few fraternities have dangerous initiation rites, and those that do have no legitimate role in campus life.
5. Only nonprofit organizations are exempt from paying taxes, so churches must be exempt.
6. All of the operas except Mozart’s were well performed, and *Carmen* was not written by Mozart.
7. Not all phone calls are welcome, but those from friends are.
8. Higher life forms could not have evolved through merely random processes, because no organized beings could have evolved that way.
9. None but great novels are timeless, and *The Brothers Karamazov* is a great novel.

10. Antiwar protests have been feeble in recent years because there is no military draft.

11. Wherever water exists, human life can be sustained, and water exists on the moon.

12. If a symphony orchestra has effective fund-raisers, it will survive; and the Cleveland symphony has survived for years.

13. Mechanistic materialists do not believe in free will, because they think that everything is governed by deterministic laws.

14. A contract to buy land is not enforceable unless it’s in writing, but our client’s contract to buy land *is* in writing.

15. The only telescopes that are unaffected by the atmosphere are orbiting telescopes, and the Hubble telescope is in orbit.

II. Translate the enthymemes in Part I of this exercise into standard-form categorical syllogisms and test them for validity.

III. The following enthymemes were originally submitted as letters to the editor of magazines and newspapers. Convert them into valid standard-form syllogisms. In some cases two syllogisms may be required.

1. If the Defense Department is so intent on fighting alcohol abuse, why does it make alcohol so readily available and acceptable? Alcohol is tax free at post liquor stores, and enlisted men’s and officers’ clubs make drinking almost a mandatory facet of military life.

   *(Diane Lynch)*

2. All aid to Israel should be stopped at once. Why should the American taxpayer be asked to send billions of dollars to Israel when every city in the United States is practically broke and millions of people are out of work?

   *(Bertha Grace)*

3. Suicide is not immoral. If a person decides that life is impossible, it is his or her right to end it.

   *(Donald S. Farrar)*

4. The best way to get people to read a book is to ban it. The fundamentalist families in Church Hill, Tennessee, have just guaranteed sales of *Macbeth*, *The Diary of Anne Frank*, *The Wizard of Oz* and other stories.

   *(Paula Fleischer)*

5. The budget deficit will not be brought under control because to do so would require our elected leaders in Washington to do the unthinkable—act courageously and responsibly.

   *(Bruce Crutchler)*
6. The Constitution bans any law that is so vague that “men of common intelligence must necessarily guess at its meaning.” Sexual harassment laws, however, are so vague that no one knows what they mean.

(Hans Bader)

7. College students of today are the higher-income taxpayers of tomorrow. Congress should consider financial aid as an investment in the financial future of our country.

(Carol A. Steime1)

8. Our genes and our environment control our destinies. The idea of conscious choice is ridiculous. Yes, prisons should be designed to protect society, but they should not punish the poor slobs who were headed for jail from birth.

(Paul R. Andrews)

9. Encouraging toy-gun play gives children a clear message that the best way to deal with frustration and conflict is with a gun. Is this the message that we want to be sending our kids?

(Patricia Owen)

10. The U.S. surgeon general’s latest report on cigarettes and cancer is an interesting example of natural selection in the late twentieth century. The intelligent members of our species will quit smoking, and survive. The dummies will continue to puff away.

(Kelly Kinnon)

IV. Page through a magazine or newspaper and identify five topics of current interest. Construct an enthymeme involving each topic.

V. Translate the arguments in the following dialogue into standard-form categorical syllogisms. The dialogue contains more than twenty-five arguments, and most are expressed in the form of enthymemes. The first translated syllogism may be found in the answer key in the back of the book.

Do Kids Make Parents Happy?

“Why don’t we take a walk in the park?” Tad says to his fiancé, Lara, as he takes her by the hand.

“Good idea,” she replies. “And while we’re at it, we can talk about our future together.” Lara pauses a moment to look at some children playing in the grass. “I know we’ve talked about this before, and I know it’s a sensitive subject, but I wish you would get over the idea of having a bunch of kids.”

“Well, I’ll think about it, but could you tell me once again why you don’t want any?” Tad replies.

“Okay,” Lara says as she takes a moment to collect her thoughts. “Here are my reasons. Many couples suffer under the delusion that kids automatically bring happiness. But that’s simply not so. Recent studies show that parents experience lower levels of
emotional well-being than couples without kids, and if that is so, then parents are less happy than childless couples.”

“I’ve read about those studies,” Tad replies slowly, “but I don’t know what to make of them. Consider this. Kids make you laugh, and laughter is essential to happiness. So kids do make you happy. And kids add depth to a marriage, and marriages with depth are the happiest. Also, having kids makes you participate in a kind of immortality. Your children grow up and have children, and those children have children, and on it goes. This feeling of being a part of an endless chain makes you happy, don’t you think?”

“Frankly,” Lara replies, “that’s all a bit too removed from the now to suit me. So let’s begin at the beginning. I agree that when a couple is expecting their first child, they tend to be happy. But once the baby arrives, the honeymoon ends. The newborn has to be fed every couple hours, and this causes terrible loss of sleep. Couples who never sleep tend not to be happy.”

“Okay, that is a problem,” replies Tad. “At least for a few months.”

“And in a year or so you have toys and food all over the house, and sticky stuff on all the furniture. How happy is living in a constant mess going to make you?”

“No very, I guess,” says Tad with a frown. “But that’s not the whole picture. Having kids will force us not to be selfish, and no one who is selfish is truly happy. Also, kids promote an atmosphere of growth. Seeing kids learn, change, and grow up make their parents happy. Don’t you think that’s true?”

“Well, yes,” says Lara reluctantly. “But there are other things to consider. When kids get a little older, they scream, whine, and throw tantrums. Having to listen to all that racket makes no one happy. And think of how hectic life will be. Kids constantly have to be driven to and from school, dancing lessons, little league, the mall. All this detracts from the happiness of their parents. No?”

“Probably you’re right on that,” Tad says as he rests against the trunk of a large maple. “But don’t forget that all kids are playful, and having playful children around you brings happiness. Also, some kids grow up to accomplish extraordinary things, which makes their parents proud; and pride always generates happiness.”

“Okay,” says Lara as she gives Tad a playful poke. “But I’m not finished yet. Kids take up a tremendous amount of time. Couples who have kids often have no time for vacations, and I know that would not make you happy. And some couples with kids don’t even have time for sex. How does that strike you?”

“That would be terrible,” Tad admits. “But maybe we could learn to manage our time better than those other couples. And that leads me to something else. Having kids will force us to work together as a couple. That will deepen our relationship, and deeper relationships are happier relationships. And don’t forget about love. Kids love you for who you are. They don’t care what you look like, whether you’re overweight, or what kind of car you drive. And being loved makes you happy.”

“Well, of course it does,” says Lara, as she gives Tad a tiny kiss. “But one thing we haven’t considered yet is money. Kids cost a fortune. Food, clothing, entertainment, and a college education will leave us constantly broke. Can we be happy if we have no money? And what about my career? I have goals too, just as you do. If I’m constantly pregnant or taking care of infant children, I’ll never achieve those goals. I can’t possibly be happy if that happens.”

“I wouldn’t want that, either,” Tad says with an understanding nod. “That’s a problem we will have to work out. As we grow older, though, think about what our lives
will be like without any children. We’ll be lonely and cut off, with no one to call us on the phone and no grandchildren to pay us a visit. Does that sound like happiness to you?"

“Ha!” says Lara with a touch of sarcasm. “You assume that the kids will eventually leave the house. You forget that we live in the age of boomerang offspring. After they finish school, they come back home to live, and you never get rid of them. How does that grab you?”

Tad laughs and says, “Well, we didn’t stay around long after college. I think when we decided to leave the nest and get married, we made our parents truly happy.”

“Yes,” Lara replies, “I think we did. And perhaps we have proved your case. Some kids, at least, have made their parents happy.”

---

**Sorites**

A *sorites* is a chain of categorical syllogisms in which the intermediate conclusions have been left out. The name is derived from the Greek word *soros*, meaning “heap,” and is pronounced “sōrītēz,” with the accent on the second syllable. The plural form is also “sorites.” Here is an example:

- All bloodhounds are dogs.
- All dogs are mammals.
- No fish are mammals.
- Therefore, no fish are bloodhounds.

The first two premises validly imply the intermediate conclusion “All bloodhounds are mammals.” If this intermediate conclusion is then treated as a premise and put together with the third premise, the final conclusion follows validly. The sorites is thus composed of two valid categorical syllogisms and is therefore valid. The rule in evaluating a sorites is based on the idea that a chain is only as strong as its weakest link. If any of the component syllogisms in a sorites is invalid, the entire sorites is invalid.

A *standard-form sorites* is one in which each of the component propositions is in standard form, each term occurs twice, the predicate of the conclusion is in the first premise, and each successive premise has a term in common with the preceding one.* The sorites in the example is in standard form. Each of the propositions is in standard form, each term occurs twice; the predicate of the conclusion, “bloodhounds,” is in the first premise; the other term is in the first premise; “dogs,” is in the second premise, and so on.

---

*Actually, there are two definitions of standard-form sorites: the Goclenian and the Aristotelian. The one given here is the Goclenian. In the Aristotelian version, the premises are arranged so that the subject of the conclusion occurs in the first premise.
We will now introduce two techniques for testing a sorites for validity. The first technique involves three steps: (1) put the sorites into standard form, (2) introduce the intermediate conclusions, and (3) test each component syllogism for validity. If each component is valid, the sorites is valid. Consider the following sorites form:

- No $B$ are $C$.
- Some $E$ are $A$.
- All $A$ are $B$.
- All $D$ are $C$.
- Some $E$ are not $D$.

To put the sorites form into standard form, the premises must be rearranged. To do this find the premise that contains the predicate of the conclusion and write it first. Then find the premise that contains the other term in the first premise and write it second. Continue in this way until all the premises are listed:

- All $D$ are $C$.
- No $B$ are $C$.
- All $A$ are $B$.
- Some $E$ are $A$.
- Some $E$ are not $D$.

Next, the intermediate conclusions are drawn. Venn diagrams are useful in performing this step, and they serve simultaneously to check the validity of each component syllogism:

The first intermediate conclusion, “No $B$ are $D$,” is drawn from the first two premises. The second, “No $A$ are $D$,” is drawn from the first intermediate conclusion and the third premise. And the third conclusion, which is identical to the final conclusion, is drawn from the second intermediate conclusion and the fourth premise. Since all conclusions are drawn validly, the sorites is valid. On the other hand, if at some step in the procedure no conclusion can be drawn, the sorites is invalid.

The second technique for testing the validity of a sorites is faster and simpler than the first one because it does not require that the intermediate conclusions be derived.
This second technique consists in applying five rules that closely resemble the rules for syllogisms. The rules are as follows:

**Rule 1:** Each of the middle terms must be distributed at least once.

**Rule 2:** If a term is distributed in the conclusion, then it must be distributed in a premise.

**Rule 3:** Two negative premises are not allowed.

**Rule 4:** A negative premise requires a negative conclusion, and a negative conclusion requires a negative premise.

**Rule 5:** If all the premises are universal, the conclusion cannot be particular.

Rule 1 refers to the “middle terms” in the sorites. These are the terms that occur in matched pairs in the premises. The conclusion referred to in Rules 2, 4, and 5 is the final conclusion of the sorites. Also, as with categorical syllogisms, if a sorites breaks only Rule 5, it is valid from the Aristotelian standpoint on condition that its terms refer to existing things.

Before applying the rules, it helps to put the sorites into standard form; in either event the sorites must be written so that the terms occur in matched pairs. The following sorites is in standard form, and the distributed terms are marked with a small “d.” As is apparent, there are three middle terms: M, K, and R.

\begin{align*}
\text{All } S \text{d are } M. \\
\text{All } K \text{d are } M. \\
\text{No } K \text{d are } R \text{d.} \\
\text{Some } F \text{ are } R. \\
\text{Some } F \text{ are not } S \text{d.}
\end{align*}

This sorites breaks Rule 1 because neither occurrence of M in the first two premises is distributed. Thus, the sorites is invalid. Note that no other rule is broken. Both of the K’s in lines 2 and 3 are distributed, one of the R’s in lines 3 and 4 is distributed, S is distributed in the conclusion and also in the first premise, there is a negative conclusion and only one negative premise, and while the conclusion is particular so is one of the premises.

The logic behind the five rules is as follows. For Rule 1, each of the middle terms in the sorites is also a middle term in one of the component syllogisms. Thus, if Rule 1 is broken, one of the component syllogisms has an undistributed middle, making the entire sorites invalid.

For Rule 2, when the sorites is in standard form, the predicate of the conclusion must appear in each of the intermediate conclusions. Thus, if the predicate of the conclusion is distributed, it must also be distributed in each of the intermediate conclusions, and also in the first premise. Otherwise, one of the component syllogisms would have either an illicit major or an illicit minor, making the entire sorites invalid. Analogously, if the subject of the conclusion is distributed, it must also be distributed in the last premise. Otherwise, the last component syllogism would have an illicit minor, making the entire sorites invalid.

For Rule 3, when a negative premise appears in the list of premises, the conclusion derived from that premise must be negative, as must all subsequent conclusions. Other
wise, one of the component syllogisms would break Rule 4 for syllogisms. If a second negative premise should appear, the syllogism consisting of that premise and the prior intermediate conclusion would commit the fallacy of exclusive premises, making the entire sorites invalid.

Similarly, for Rule 4, when a negative premise appears in the list of premises, all subsequent conclusions must be negative. Otherwise, one of the component syllogisms would break Rule 4 for syllogisms. Conversely, if the conclusion of the sorites is negative, either the last premise or the last intermediate conclusion must be negative. Otherwise, the last component syllogism would break Rule 4 for syllogisms. If the last intermediate conclusion is negative, then either the prior premise or the prior intermediate conclusion must be negative. If we continue this reasoning, we see that some prior premise must be negative.

For Rule 5, a particular conclusion has existential import, while universal premises (from the Boolean standpoint) do not. Thus, if all the premises are universal and the conclusion is particular, the sorites as a whole commits the existential fallacy.

One of the advantages of the rules method for testing a sorites is that invalidity can often be detected through immediate inspection. Once a sorites has been put into standard form, any sorites having more than one negative premise is invalid, and any sorites having a negative premise and an affirmative conclusion (or vice versa) is invalid. Also, as with syllogisms, any sorites having more than one particular premise is invalid. This last requirement is implied by the other rules.

**Exercise 5.7**

1. Rewrite the following sorites in standard form, reducing the number of terms when necessary. Then supply the intermediate conclusions and test with Venn diagrams.

★ 1. No \(B\) are \(C\).
    * Some \(D\) are \(C\).
    * All \(A\) are \(B\).
    * Some \(D\) are not \(A\).

2. No \(C\) are \(D\).
    * All \(A\) are \(B\).
    * Some \(C\) are not \(B\).
    * Some \(D\) are not \(A\).

3. No \(S\) are \(M\).
    * All \(F\) are \(S\).
    * Some \(M\) are \(H\).
    * All \(E\) are \(F\).
    * Some \(H\) are not \(E\).

★ 4. Some \(T\) are \(K\).
    * No \(K\) are \(N\).
    * Some \(C\) are \(Q\).
    * All \(T\) are \(C\).
    * Some \(Q\) are not \(N\).

5. No \(A\) are non-\(B\).
    * No \(C\) are \(B\).
    * All non-\(A\) are non-\(D\).
    * No \(D\) are \(C\).

6. All \(M\) are non-\(P\).
    * Some \(M\) are \(S\).
    * All \(K\) are \(P\).
    * Some non-\(K\) are not non-\(S\).
7. All non-\(U\) are non-\(V\).
   - No \(U\) are non-\(W\).
   - All \(V\) are \(Y\).
   - No \(X\) are \(W\).
   - All \(Y\) are non-\(X\).

8. All \(D\) are non-\(C\).
   - All non-\(B\) are non-\(A\).
   - Some \(E\) are \(D\).
   - All \(B\) are \(C\).
   - Some non-\(A\) are not non-\(E\).

9. All non-\(L\) are non-\(K\).
   - Some \(K\) are \(M\).
   - All \(P\) are non-\(L\).
   - No non-\(N\) are \(M\).
   - No \(Q\) are non-\(P\).
   - Some \(N\) are not \(Q\).

10. All \(R\) are \(S\).
    - No non-\(V\) are \(T\).
    - No \(Q\) are non-\(R\).
    - No non-\(Q\) are \(P\).
    - All \(T\) are non-\(S\).
    - All \(V\) are non-\(P\).

II. For the sorites in Part I, rewrite each in standard form, reducing the number of terms when necessary. Then use the five rules for sorites to test each for validity.

III. The following sorites are valid. Rewrite each sorites in standard form, using letters to represent the terms and reducing the number of terms whenever necessary. Then use Venn diagrams or the rules method to prove each one valid.

\begin{itemize}
  \item \textbf{1.} Whatever produces oxygen supports human life.
  - Rain forests produce oxygen.
  - Nothing that supports human life should be destroyed.
  - Rain forests should not be destroyed.

  \item \textbf{2.} No restrictive trade policies fail to invite retaliation.
  - Trade wars threaten our standard of living.
  - Some Japanese trade policies are restrictive.
  - Policies that invite retaliation lead to a trade war.
    - Some Japanese trade policies threaten our standard of living.

  \item \textbf{3.} Anything that poisons drinking water causes disease and death.
  - Chemicals percolating through the soil contaminate aquifers.
  - Dumped chemicals percolate through the soil.
  - Whatever contaminates aquifers poisons drinking water.
    - Dumped chemicals cause disease and death.

  \item \textbf{4.} Nothing that is brittle is ductile.
  - Superconductors are all ceramics.
  - Only ductile things can be pulled into wires.
  - Ceramics are brittle.
    - Superconductors cannot be pulled into wires.

  \item \textbf{5.} Some college students purchase their term papers.
  - Any cheat is expelled from college.
  - No one will achieve his career goals who is expelled.
  - No one who purchases term papers is other than a cheat.
    - Some college students will not achieve their career goals.
\end{itemize}
6. Creation science does not favor the teaching of evolution. Nothing should be taught that frustrates the understanding of life. Whatever opposes the teaching of evolution impedes the learning of biology. Anything that enhances the understanding of life fosters the learning of biology. Creation science should not be taught.

7. Whoever gives birth to crack babies increases future crime rates. Some pregnant women use crack. None but criminals increase future crime rates. Pregnant crack users never give birth to anything but crack babies. Some pregnant women are criminals.

8. Whatever retards population growth increases food availability. Anything that prevents starvation enhances life. Birth control measures never accelerate population growth. Anything that enhances life should be encouraged. Whatever increases food availability prevents starvation. Birth control measures should not be discouraged.

9. A few countries allow ivory trading. Whatever country resists elephant killing discourages poachers. Any country that allows ivory trading encourages poachers. No country that promotes the extinction of elephants should escape the condemnation of the civilized world. Any country that supports elephant killing promotes the extinction of elephants. A few countries should be condemned by the civilized world.

10. Anything that promotes skin cancer causes death. Whatever preserves the ozone layer prevents the release of CFCs. Nothing that resists skin cancer increases UV radiation. Anything that destroys the ozone layer increases UV radiation. There are packaging materials that release CFCs. Nothing that causes death should be legal. Some packaging materials should be illegal.

IV. The following sorites are taken from Lewis Carroll's *Symbolic Logic*. All are valid. Rewrite each sorites in standard form, using letters to represent the terms and reducing the number of terms whenever necessary. Then use Venn diagrams or the rules method to prove each one valid.

1. No ducks waltz. No officers ever decline to waltz. All my poultry are ducks. My poultry are not officers.

2. No experienced person is incompetent. Jenkins is always blundering. No competent person is always blundering. Jenkins is inexperienced.
3. No terriers wander among the signs of the zodiac.
   Nothing that does not wander among the signs of the zodiac is a comet.
   Nothing but a terrier has a curly tail.
   No comet has a curly tail.

4. All hummingbirds are richly colored.
   No large birds live on honey.
   Birds that do not live on honey are dull in color.
   All hummingbirds are small.

5. All unripe fruit is unwholesome.
   All these apples are wholesome.
   No fruit grown in the shade is ripe.
   These apples were grown in the sun.

6. All my sons are slim.
   No child of mine is healthy who takes no exercise.
   All gluttons who are children of mine are fat.
   No daughter of mine takes any exercise.
   All gluttons who are children of mine are unhealthy.

7. The only books in this library that I do not recommend for reading are unhealthy in tone.
   The bound books are all well-written.
   All the romances are healthy in tone.
   I do not recommend you to read any of the unbound books.
   All the romances in this library are well-written.

8. No interesting poems are unpopular among people of real taste.
   No modern poetry is free from affectation.
   All your poems are on the subject of soap bubbles.
   No affected poetry is popular among people of real taste.
   No ancient poem is on the subject of soap bubbles.
   All your poems are uninteresting.

9. All writers who understand human nature are clever.
   No one is a true poet unless he can stir the hearts of men.
   Shakespeare wrote Hamlet.
   No writer who does not understand human nature can stir the hearts of men.
   None but a true poet could have written Hamlet.
   Shakespeare was clever.

10. I trust every animal that belongs to me.
    Dogs gnaw bones.
    I admit no animals into my study unless they beg when told to do so.
    All the animals in the yard are mine.
    I admit every animal that I trust into my study.
    The only animals that are really willing to beg when told to do so are dogs.
    All the animals in the yard gnaw bones.
Summary

Categorical Syllogism:
- A deductive argument consisting of three categorical propositions
- Containing three different terms
- Each term occurs twice in distinct propositions

Terms in a categorical syllogism:
- Major term: The term that occurs in the predicate of the conclusion
- Minor term: The term that occurs in the subject of the conclusion
- Middle term: The term that occurs twice in the premises

Premises of a categorical syllogism:
- Major premise: The premise that contains the major term
- Minor premise: The premise that contains the minor term

Standard-form categorical syllogism:
- All three propositions are in standard form.
- The two occurrences of each term are identical.
- Each term is used in the same sense throughout the argument.
- The major premise is listed first, minor premise second, conclusion last.

The validity of a categorical syllogism is determined by its mood and figure:
- Mood: Consists of the letter names of the propositions in the syllogism
- Figure: Is determined by how the occurrences of the middle term are arranged

Tables for categorical syllogisms:
- Unconditionally valid: Lists all forms valid from the Boolean standpoint
- Conditionally valid: Lists additional forms valid from the Aristotelian standpoint

Venn diagrams: To test a syllogism:
- Enter the information from the premises into the diagram
- Look at the completed diagram to see if it supports the conclusion
- If a syllogism having universal premises and a particular conclusion is not valid from the Boolean standpoint, test it from the Aristotelian standpoint.

Rules for syllogisms: For a syllogism to be valid from the Boolean standpoint:
- The middle term must be distributed in at least one premise;
- A term distributed in the conclusion must also be distributed in a premise;
- At least one premise must be affirmative;
• A negative conclusion requires a negative premise, and vice versa;
• A particular conclusion requires a particular premise.

If only the last rule is violated, a syllogism is valid from the Aristotelian standpoint on condition that the critical term refers to actually existing things.

Some syllogisms having more than three terms can be reduced to standard form:
• Each additional term must be a complement of one of the others.
• Conversion, obversion, and contraposition must be applied only when they yield logically equivalent results.

Ordinary language syllogisms: The component propositions are not in standard form.
• Can be converted into standard form syllogisms by applying the techniques presented in Section 4.7.

Enthymemes: Syllogisms that are missing a premise or conclusion
• Can be converted into standard form syllogisms by supplying the missing statement.

Sorites: A chain of syllogisms in which the intermediate conclusions are missing

Testing a sorites:
• Using the five rules:
  ■ Put the sorites into standard form.
  ■ Apply the rules.
• Using Venn diagrams
  ■ Put the sorites into standard form.
  ■ Supply the missing intermediate conclusions.
  ■ Test each component syllogism.