**CHAPTER I: THE NATURE OF ARGUMENT**

* 1. **Basic Concepts: Arguments, Premises, and Conclusions**

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

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

As is apparent from the above definition, the term ‘‘argument’’ has a very specific meaning in logic. It does not mean, for example, a mere verbal fight, as one might have with one’s parent, spouse, or friend. Let us examine the features of this definition in greater detail. First of all, an argument is a group of statements. A **statement** is a sentence that is either true or false—in other words, typically a declarative sentence or a sentence component that could stand as a declarative sentence. The following sentences are statements:

Aluminum is attacked by hydrochloric acid.

Broccoli is a good source of vitamin A.

Argentina is located in North America.

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

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

What is the atomic weight of carbon?

Let’s go to the park today.

We suggest that you travel by bus.

Turn to the left at the next corner.

All right!

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

All crimes are violations of the law.

Theft is a crime.

Therefore, theft is a violation of the law.

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

Some crimes are misdemeanors.

Murder is a crime.

Therefore, murder is a misdemeanor.

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

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

Therefore it follows that wherefore implies that

we may conclude entails that hence as a result accordingly

thus consequently we may infer

it must be that whence so

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

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

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

|  |
| --- |
| Premises Claimed evidence |
| Conclusion What is claimed to follow from the evidence |

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

since as indicated by for the reason that because

for in that owing to may be inferred from

as given that inasmuch as seeing that

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

Example:

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

The premise of this argument is ‘‘The use of these drugs can jeopardize the development of the fetus,’’ and the conclusion is ‘‘Expectant mothers should never use recreational drugs.’’ One premise indicator not included in the above list is ‘‘for this reason.’’ This indicator is special in that it comes immediately *after* the premise that it indicates. ‘‘For this reason’’ (except when followed by a colon) means for the reason (premise) that was just given. In other words, the premise is the statement that occurs immediately *before* ‘‘for this reason.’’ One should be careful not to confuse ‘‘for this reason’’ with ‘‘for the reason that.’’

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

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

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

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

The space program deserves increased expenditures in the years ahead. Not only does the national defense depend upon it, but the program will more than pay for itself in terms of technological spinoffs. Furthermore, at current funding levels the program cannot fulfill its anticipated potential.

The conclusion of this argument is the first statement, and all of the other statements are premises. The argument illustrates the pattern found in most arguments that lack indicator words: the intended conclusion is stated first, and the remaining statements are then offered in support of this first statement. When the argument is restructured according to logical principles, however, the conclusion is always listed *after* the premises:

P1: The national defense is dependent upon the space program.

P2: The space program will more than pay for itself in terms of technological spinoffs.

P3: At current funding levels the space program cannot fulfill its anticipated potential.

C: The space program deserves increased expenditures in the years ahead.

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

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

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

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

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

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

In the loose sense of the term, ‘‘inference’’ is used interchangeably with ‘‘argument.’’ Analogously, a **proposition,** in the technical sense, is the meaning or information content of a statement. For the purposes of this book, however, ‘‘proposition’’ and ‘‘statement’’ are used interchangeably.

**Exercises are canceled. Please read it from the book!**

**1.2: Recognizing Arguments**

Not all passages contain arguments. Because logic deals with arguments, it is important to be able to distinguish passages that contain arguments from those that do not. In general, a passage contains an **argument if it purports to prove something**; if it does not do so, it does not contain an argument. **Two conditions** must be fulfilled for a passage to purport to prove something:

(1) At least one of the statements must claim to present evidence or reasons.

(2) There must be a claim that the alleged evidence or reasons supports or implies something—that is, a claim that something follows from the alleged evidence.

As we have seen the statements that claim to present the evidence or reasons are the premises and the statement that the evidence is claimed to support or imply is the conclusion. It is not necessary that the premises present actual evidence or true reasons nor that the premises actually support the conclusion. But at least the premises must *claim* to present evidence or reasons, and there must be a *claim* that the evidence or reasons support or imply something.

The first condition expresses a **factual claim,** and deciding whether it is fulfilled usually presents few problems. Thus, most of our attention will be concentrated on whether the second condition is fulfilled. This second condition expresses what is called an **inferential claim.** The inferential claim is simply the claim that the passage expresses a certain kind of ***reasoning process***—that something supports or implies something or that something follows from something. Such a claim can be either explicit or implicit.

An ***explicit***inferential claim is usually asserted by premise or conclusion indicator words (‘‘thus,’’ ‘‘since,’’ ‘‘because,’’ ‘‘hence,’’ ‘‘therefore,’’ and so on). Example:

Mad cow disease is spread by feeding parts of infected animals to cows, and this practice has yet to be completely eradicated. Thus, mad cow disease continues to pose a threat to people who eat beef.

The word ‘‘thus’’ expresses the claim that something is being inferred, so the passage is an argument.

An ***implicit***inferential claim exists if there is an inferential relationship between the statements in a passage. Example:

The price reduction [seen with the electronic calculator] is the result of a technological revolution. The calculator of the 1960s used integrated electronic circuits that contained about a dozen transistors or similar components on a single chip. Today, mass-produced chips, only a few millimeters square, contain several thousand such components.

The inferential relationship between the first statement and the other two constitutes an implicit claim that evidence supports something, so we are justified in calling the passage an argument. The first statement is the conclusion, and the other two are the premises.

In deciding whether there is a claim that evidence supports or implies something, keep an eye out for :**(1)** indicator words and **(2)** the presence of an inferential relationship between the statements. In connection with these points, however, a word of *caution* is in order. **First**, the mere occurrence of an indicator word by no means guarantees the presence of an argument. For example, consider the following passages:

Since Edison invented the phonograph, there have been many technological developments.

Since Edison invented the phonograph, he deserves credit for a major technological development.

In the first passage the word ‘‘since’’ is used in a *temporal* sense. It means ‘‘from the time that.’’ Thus, the first passage is not an argument. In the second passage ‘‘since’’ is used in a *logical* sense, and so the passage *is* an argument.

**The second** cautionary point is that it is not always easy to detect the occurrence of an inferential relationship between the statements in a passage, and the reader may have to review a passage several times before making a decision. In reaching such a decision, it sometimes helps to mentally insert the word ‘‘therefore’’ before the various statements to see whether it makes sense to interpret one of them as following from the others. Even with this mental aid, however, the decision whether a passage contains an inferential relationship (as well as the decision about indicator words) often involves a heavy dose of interpretation. As a result, not everyone will agree about every passage. Sometimes the only answer possible is a conditional one: ‘‘*If* this passage contains an argument, then these are the premises and that is the conclusion.’’

To assist in distinguishing passages that contain arguments from those that do not, let us now investigate some typical kinds of non-arguments. These include simple non-inferential passages, expository passages, illustrations, explanations, and conditional statements.

**Simple Non-inferential Passages (Non argument expressions)**

Simple non-inferential passages are unproblematic passages that **lack a claim that anything is being proved**. Such passages contain statements that could be premises or conclusions (or both), but what is missing is a claim that any potential premise supports a conclusion or that any potential conclusion is supported by premises. Passages of this sort include warnings, pieces of advice, statements of belief or opinion, loosely associated statements, and reports.

1. (a) A **warning** is a form of expression that is intended to put someone on guard against a dangerous or detrimental situation. Examples:

Watch out that you don’t slip on the ice.

Whatever you do, never confide personal secrets to Blabbermouth Bob.

If no evidence is given to prove that such statements are true, then there is no argument.

(b) A **piece of advice** is a form of expression that makes a recommendation about some future decision or course of conduct. Examples:

You should keep a few things in mind before buying a used car. Test drive the car at varying speeds and conditions, examine the oil in the crankcase, ask to see service records, and, if possible, have the engine and power train checked by a mechanic.

Before accepting a job after class hours, I would suggest that you give careful consideration to your course load. Will you have sufficient time to prepare for classes and tests, and will the job produce an excessive drain on your energies?

As with warnings, if there is no evidence that is intended to prove anything, then there is no argument.

1. A **statement of belief** or **opinion** is an expression about what someone happens to believe or think at a certain time. Examples:

We believe that our company must develop and produce outstanding products that will perform a great service or fulfill a need for our customers. We believe that our business must be run at an adequate profit and that the services and products we offer must be better than those offered by competitors.

I think a nation such as ours, with its high moral traditions and commitments, has a further responsibility to know how we became drawn into this conflict, and to learn the lessons it has to teach us for the future.

Because neither of these authors makes any claim that his belief or opinion is supported by evidence, or that it supports some conclusion, there is no argument.

1. **Loosely associated statements** may be about the same general subject, but they lack a claim that one of them is proved by the others. Example:

Not to honor men of worth will keep the people from contention; not to value goods that are hard to come by will keep them from theft; not to display what is desirable will keep them from being unsettled of mind.

Because there is no claim that any of these statements provides evidence or reasons for believing another, there is no argument.

Nations are made in two ways, by the slow working of history or the galvanic force of ideas. Most nations are made the former way, emerging slowly from the mist of the past, gradually coalescing within concentric circles of shared sympathies, with an accretion of consensual institutions. But a few nations are formed and defined by the citizens’ assent to a shared philosophy.

1. A **report** consists of a group of statements that convey information about some situation,topic or event. Example:

Even though more of the world is immunized than ever before, many old diseases have proven quite resilient in the face of changing population and environmental conditions, especially in the developing world. New diseases, such as AIDS, have taken their toll in both the North and the South.

These statements could serve as the premises of an argument; but because the author makes no claim that they support or imply anything, there is no argument. Another type of report is the news report:

A powerful car bomb blew up outside the regional telephone company headquarters in Medellin, injuring 25 people and causing millions of dollars of damage to nearby buildings, police said. A police statement said the 198-pound bomb was packed into a milk churn hidden in the back of a stolen car.

Again, because the reporter makes no claim that these statements imply anything, there is no argument. One must be careful, though, with reports *about* arguments:

‘‘The Air Force faces a serious shortage of experienced pilots in the years ahead, because repeated overseas tours and the allure of high paying jobs with commercial airlines are winning out over lucrative bonuses to stay in the service,’’ says a prominent Air Force official.

Properly speaking, this passage is not an argument, because the author of the passage does not claim that anything is supported by evidence. Rather, the author reports the claim by the Air Force official that something is supported by evidence. If such passages are interpreted as ‘‘containing’’ arguments, it must be made clear that the argument is not the author’s but one made by someone about whom the author is reporting.

1. **Expository Passages** is a kind of discourse that begins with a topic sentence followed by one or more sentences that develop the topic sentence. If the objective is not to prove the topic sentence but only to expand it or elaborate it, then there is no argument. Examples:

There are three familiar states of matter: solid, liquid, and gas. Solid objects ordinarily maintain their shape and volume regardless of their location. A liquid occupies a definite volume, but assumes the shape of the occupied portion of its container. A gas maintains neither shape nor volume. It expands to fill completely whatever container it is in.

There is a stylized relation of artist to mass audience in the sports, especially in baseball. Each player develops a style of his own—the swagger as he steps to the plate, the unique windup a pitcher has, the clean-swinging and hard-driving hits, the precision quickness and grace of infield and outfield, the sense of surplus power behind whatever is done.

In each passage the topic sentence is stated first, and the remaining sentences merely develop and flesh out this topic sentence. These passages are not arguments because they lack an inferential claim. However, expository passages differ from simple non-inferential passages (such as warnings and pieces of advice) in that many of them can also be taken as arguments. If the purpose of the subsequent sentences in the passage is not only to flesh out the topic sentence but also to prove it, then the passage is an argument. Example:

Skin and the mucous membrane lining the respiratory and digestive tracts serve as mechanical barriers to entry by microbes. Oil gland secretions contain chemicals that weaken or kill bacteria on skin. The respiratory tract is lined by cells that sweep mucus and trapped particles up into the throat, where they can be swallowed. The stomach has an acidic pH, which inhibits the growth of many types of bacteria.

In this passage the topic sentence is stated first, and the purpose of the remaining sentences is not only to *show how* the skin and mucous membranes serve as barriers to microbes but to *prove* that they do this. Thus, the passage can be taken as both an expository passage and an argument.

In deciding whether an expository passage should be interpreted as an argument, try to determine whether the purpose of the subsequent sentences in the passage is merely to develop the topic sentence or also to prove it. In borderline cases, ask yourself whether the topic sentence makes a claim that everyone accepts or agrees with. If it does, the passage is probably not an argument. In real life situations authors rarely try to prove something that everyone already accepts. However, if the topic sentence makes a claim that many people do not accept or have never thought about, then the purpose of the remaining sentences may be both to prove the topic sentence as well as to develop it. If this be so, the passage is an argument.

Finally, if even this procedure yields no definite answer, the only alternative may be to say that *if* the passage is taken as an argument, then the first statement is the conclusion and the others are the premises.

1. **Illustrations**

An **illustration** consists of a statement about a certain subject combined with a reference to one or more specific instances intended to exemplify that statement. Illustrations are often confused with arguments because many of them contain indicator words such as ‘‘thus.’’ Examples:

Chemical elements, as well as compounds, can be represented by molecular formulas.

Thus, oxygen is represented by ‘‘O2,’’ water by ‘‘H2O,’’ and sodium chloride by ‘‘NaCl.’’

Whenever a force is exerted on an object, the shape of the object can change. For example, when you squeeze a rubber ball or strike a punching bag with your fist, the objects are deformed to some extent.

These selections are not arguments because they make no claim that anything is being proved. In the first selection, the word ‘‘thus’’ indicates how something is done— namely, how chemical elements and compounds can be represented by formulas. In the second selection, the example cited is intended to give concrete meaning to the notion of a force changing the shape of something. It is not intended primarily to prove *that* a force can change the shape of something.

However, as with expository passages, many illustrations can be taken as arguments.

Such arguments are often called **arguments from example.** Here is an instance of one:

You just said that no mammals can fly, but that is inaccurate. At least one mammal has wings and can fly. For example bats are mammals.

Water is an excellent solvent. It can dissolve a wide range of materials that will not dissolve in other liquids (conclusion). For example, salts do not dissolve in most common solvents, such as gasoline, kerosene, turpentine and cleaning fluids. But many salts dissolve readily in water. So do a variety of nonionic organic substances, such as sugars and alcohols of low molecular weight.

In these passages the examples that are cited can be interpreted as providing evidence or support. Thus, the passages can be taken as both an illustration and an argument.

In deciding whether an illustration should be interpreted as an argument one must determine whether the passage merely shows how something is done or what something means, or whether it also purports to prove something. In borderline cases it helps to note whether the claim being illustrated is one that practically everyone accepts or agrees with. If it is, the passage is probably not an argument. As we have already noted, in real life situations authors rarely attempt to prove what everyone already accepts. But if the claim being illustrated is one that many people do not accept or have never thought about, then the passage may be interpreted as both an illustration and an argument.

Thus, in reference to the first two examples we considered, most people are aware that elements and compounds can be expressed by formulas—practically everyone knows that water is H2O—and most people know that forces distort things—that running into a tree can cause a dent in the car bumper. But people may not be aware of the fact that water dissolves many things that other solvents will not dissolve. This is one of the reasons for evaluating the first two examples as mere illustrations and the last one as an argument.

1. **Explanations**

An **explanation** is a group of statements that purports to **shed light** on some event or phenomenon.The event or phenomenon in question is usually accepted as a matter of fact. In explanation, statements are used not to *provide evidence* for another statement, but to *provide explanations or reasons* for the occurrence of some phenomenon.

Examples:

* Wars occur because humans desire to control other humans.
* The sky appears blue from the earth’s surface because light rays from the sun are scattered by particles in the atmosphere.
* Cows can digest grass, while humans cannot, because their digestive systems contain enzymes not found in humans.

Every explanation is composed of two distinct components: the explanandum and explanans. The **explanandum** is the statement that describes the event or phenomenon to be explained, and the **explanans** is the statement or group of statements that purports to do the explaining. In the first example above, the explanandum is the statement ‘‘wars occur,’’ and the explanans is ‘‘humans desire to control other humans.”

|  |
| --- |
| Premises **→**  Accepted facts  **→** Claimed to prove  Conclusion |

|  |
| --- |
| Explanans  **→** Claimed to shed light on  Explanandum **→** Accepted facts |

Explanations are sometimes mistaken for arguments because they often contain the indicator word ‘‘because.’’ Yet explanations are not arguments because in an explanation the purpose of the explanans is to shed light on, or to make sense of, the explanandum event—not to prove that it occurred. In other words, the purpose of the explanans is to show *why* something is the case, while in an argument, the purpose of the premises is to prove *that* something is the case.

In the first example above, the fact that wars occur is known to everyone. The statement that humans desire to control other humans is not intended to prove *that* wars occur but rather to show *why* it occurred. In the second example, the fact that the sky is blue is readily apparent. The intention of the passage is to explain *why* it appears blue—not to prove *that* it appears blue.

Similarly, in the third example, virtually everyone knows that people cannot digest grass. The intention of the passage is to explain *why* this is true.

Thus, to distinguish explanations from arguments, identify the statement that is either the explanandum or the conclusion (usually this is the statement that precedes the word ‘‘because’’). If this statement describes an accepted matter of fact, and if the remaining statements purport to shed light on this statement, then the passage is an explanation.

This method works for practically all passages that are either explanations or arguments (but not both). However, as with expository passages and illustrations, there are some passages that can be interpreted as both explanations and arguments. Example:

Women become intoxicated by drinking a smaller amount of alcohol than men because men metabolize part of the alcohol before it reaches the bloodstream whereas women do not.

The purpose of this passage could be to prove the first statement to those people who do not accept it as fact, and to shed light on that fact to those people who do accept it. Alternately, the passage could be intended to prove the first statement to a single person who accepts its truth on blind faith or incomplete experience, and simultaneously to shed light on this truth. Thus, the passage can be correctly interpreted as both an explanation and an argument.

Perhaps the greatest problem confronting the effort to distinguish explanations from arguments lies in determining whether something is an accepted matter of fact. Obviously what is accepted by one person may not be accepted by another. Thus, the effort often involves determining which person or group of people the passage is directed to—the intended audience. Sometimes the source of the passage (textbook, newspaper, technical journal, etc.) will decide the issue. But when the passage is taken totally out of context, this may prove impossible. In those circumstances the only possible answer may be to say that *if* the passage is an argument, then such-and-such is the conclusion and such-and-such are the premises.

1. **Conditional Statements**

A **conditional statement** is an ‘‘if . . . then . . .’’ statement; for example,

If air is removed from a solid closed container, then the container will weigh less than it did.

Every conditional statement is made up of two component statements. The component statement immediately following the ‘‘if’’ is called the **antecedent,** and the one following the ‘‘then’’ is called the **consequent.** (Occasionally, the word ‘‘then’’ is left out, and occasionally the order of antecedent and consequent is reversed.) In the above example the antecedent is ‘‘Air is removed from a solid closed container,’’ and the consequent is ‘‘the container will weigh less than it did.’’ This example asserts a causal connection between the air being removed and the container weighing less.

However, not all conditional statements express causal connections. The statement ‘‘If yellow fever is an infectious disease, then the Arsenal is a football team’’ is just as much a conditional statement as the one about the closed container.

A conditional statement is hypothetical in nature. For example:

If Lensa works hard, then she will get a promotion.

The statement merely asserts that if Lensa works hard, then she will get a promotion. It does not assert that Lensa works hard. Nor does it assert that she will get a promotion.

**Conditional statements**

If\_\_\_\_\_\_ Antecedent \_\_\_ then\_\_\_ Consequent\_\_\_\_\_\_\_\_\_ .

\_\_\_\_\_\_ Consequen\_\_\_\_ if\_\_\_\_\_\_\_ Antecedent \_\_\_\_\_\_\_\_ .

Conditional statements are not arguments, because they fail to meet the criteria given earlier. In an argument, at least one statement must claim to present evidence, and there must be a claim that this evidence implies something. In a conditional statement, there is no claim that either the antecedent or the consequent presents evidence. In other words, there is no assertion that either the antecedent or the consequent is true. Rather, there is only the assertion that *if* the antecedent is true, then so is the consequent. Of course, a conditional statement as a whole may present evidence because it asserts a relationship between statements. Yet when conditional statements are taken in this sense, there is still no argument, because there is then no separate claim that this evidence implies anything.

Some conditional statements are similar to arguments, however, in that they express the outcome of a reasoning process. As such, they may be said to have a certain inferential content. Consider the following:

If both Saturn and Uranus have rings, then Saturn has rings.

If iron is less dense than mercury, then it will float in mercury.

The link between the antecedent and consequent of these conditional statements resembles the inferential link between the premises and conclusion of an argument. Yet there is a difference because the premises of an argument are claimed to be true, whereas no such claim is made for the antecedent of a conditional statement. Accordingly, these conditional statements are not arguments.\* Yet their inferential content may be reexpressed to form arguments:

* Both Saturn and Uranus have rings. Therefore, Saturn has rings.
* Iron is less dense than mercury. Therefore, iron will float in mercury.

Finally, while no single conditional statement is an argument, a conditional statement may serve as either the premise or the conclusion (or both) of an argument, as the following examples illustrate:

* If cigarette companies publish warning labels, then smokers assume the risk of smoking. Cigarette companies do publish warning labels. Therefore, smokers assume the risk of smoking.
* If banks make bad loans, then they will be threatened with collapse. If banks are threatened with collapse, then the taxpayer will come to the rescue. Therefore, if banks make bad loans, then the taxpayer will come to the rescue.

The relation between conditional statements and arguments may now be summarized as follows:

1**. A single conditional statement is not an argument.**

**2. A conditional statement may serve as either the premise or the conclusion (or both) of an argument.**

**3. The inferential content of a conditional statement may be reexpressed to form an argument.**

The first two rules are especially pertinent to the recognition of arguments. According to the first rule, if a passage consists of a single conditional statement, it is not an argument. But if it consists of a conditional statement together with some other statement, then, by the second rule, it *may* be an argument, depending on such factors as the presence of indicator words and an inferential relationship between the statements.

Conditional statements are especially important in logic because they express the relationship between **necessary and sufficient conditions**. *A* is said to be a sufficient condition for *B* whenever the occurrence of *A* is all that is needed for the occurrence of *B.* For example, being a dog is a sufficient condition for being an animal. On the other hand, *B* is said to be a necessary condition for *A* whenever *A* cannot occur without the occurrence of *B.* Thus, being an animal is a necessary condition for being a dog. These relationships are expressed in the following conditional statements:

If *X* is a dog, then *X* is an animal.

If *X* is not an animal, then *X* is not a dog.

The first statement says that being a dog is a sufficient condition for being an animal and the second that being an animal is a necessary condition for being a dog. However, a little reflection reveals that these two statements say exactly the same thing.

Thus each expresses in one way a necessary condition and in another way a sufficient condition. The terminology of sufficient and necessary conditions will be used in later chapters to express definitions and causal connections.

**Exercises are canceled. Please read it from the book!**

**1.3: Deduction and Induction**

Arguments can be divided into two groups: deductive and inductive. A **deductive argument** is an argument in which the premises are claimed to support the conclusionin such a way that it is *impossible* for the premises to be true and the conclusionfalse. In such arguments the conclusion is claimed to follow *necessarily* from thepremises. On the other hand, an **inductive argument** is an argument in which thepremises are claimed to support the conclusion in such a way that it is *improbable* thatthe premises be true and the conclusion false. In these arguments the conclusion isclaimed to follow only *probably* from the premises. Thus, deductive arguments arethose that involve *necessary* reasoning, and inductive arguments are those that involve*probabilistic* reasoning. Examples:

* Americans are closely related to Europeans.

Americans directly elect their president. Therefore, probably Europeans directly elect their president.

* All Ethiopians are human beings.

All human beings are living things. Therefore, it necessarily follows that all Ethiopians are living thing.

The first of these arguments is inductive, the second deductive.

The distinction between inductive and deductive arguments lies in the strength of an argument’s inferential claim. In other words, the distinction lies in how strongly the conclusion is claimed to follow from the premises. Unfortunately, however, in most arguments the strength of this claim is not explicitly stated, so we must use our interpretive abilities to evaluate it. **Three factors** that influence our decision about this claim are (1) the occurrence of special indicator words, (2) the *actual* strength of the inferential link between premises and conclusion, and (3) the character or form of argumentation the arguer uses.

1. **The occurrence of special indicator words** is illustrated in the examples we just considered. The word ‘‘probably’’ in the conclusion of the first argument suggests that the argument should be taken as inductive, and the word ‘‘necessarily’’ in the conclusion of the second suggests that the second argument be taken as deductive. Additional inductive indicators are ‘‘improbable,’’ ‘‘plausible,’’ ‘‘implausible,’’ ‘‘likely,’’ ‘‘unlikely,’’ and ‘‘reasonable to conclude.’’ Additional deductive indicators are ‘‘certainly,’’ ‘‘absolutely,’’ and ‘‘definitely.’’ (Note that the phrase ‘‘it must be the case that’’ is ambiguous; ‘‘must’’ can indicate either probability or necessity).

Inductive and deductive indicator words often suggest the correct interpretation. However, if they conflict with one of the other criteria (discussed shortly), we should probably ignore them. Arguers often use phrases such as ‘‘it certainly follows that’’ for rhetorical purposes to add impact to their conclusion and not to suggest that the argument be taken as deductive. Similarly, some arguers, not knowing the distinction between inductive and deductive, will claim to ‘‘deduce’’ a conclusion when their argument is more correctly interpreted as inductive.

1. The second factor that bears upon our interpretation of an argument as inductive or deductive is **the *actual* strength of the inferential link** between premises and conclusion. If the conclusion actually does follow with strict necessity from the premises, the argument is clearly deductive. In such an argument it is impossible for the premises to be true and the conclusion false. On the other hand, if the conclusion does not follow with strict necessity but does follow probably, it is usually best to consider the argument inductive. Examples:

* All saleswomen are assertive persons.

Elizabeth Taylor is a saleswoman. Therefore, Elizabeth Taylor is an assertive person.

* The vast majority of saleswomen are assertive persons.

Elizabeth Taylor is a saleswoman. Therefore, Elizabeth Taylor is an assertive person.

In the first example, the conclusion follows with strict necessity from the premises. If we assume that all saleswomen are assertive persons and that Elizabeth Taylor is a saleswoman, then it is impossible that Elizabeth Taylor not be an assertive persons. Thus, we should interpret this argument as deductive. In the second example, the conclusion does not follow from the premises with strict necessity, but it does follow with some degree of probability. If we assume that the premises are true, then based on that assumption it is improbable that the conclusion is false. Thus, it is best to interpret the second argument as inductive.

1. Occasionally, an argument contains no indicator words, and the conclusion does not follow either necessarily or probably from the premises; in other words, it does not follow at all. This situation points up the need for the **third factor** to be taken into account, which is **the character or form of argumentation the arguer uses**. There are typically deductive forms and typically inductive forms of arguments.
2. Accordingly, five examples of argumentation that are **typically deductive are arguments** are the following: chapters.
3. An **argument based on mathematics** is an argument in which the conclusion depends on some purely arithmetic or geometric computation or measurement. For example, a shopper might place two apples and three oranges into a paper bag and then conclude that the bag contains five pieces of fruit. Or a surveyor might measure a square piece of land and, after determining that it is 100 feet on each side, conclude that it contains 10,000 square feet. Since all arguments in pure mathematics are deductive, we can usually consider arguments that depend on mathematics to be deductive as well. A noteworthy exception, however, is arguments that depend on statistics. As we will see shortly, such arguments are usually best interpreted as inductive. More Examples:

Because triangle A is congruent with triangle B, and triangle A is isosceles, it follows that triangle B is isosceles.

The Matterhorn is higher than Mount Whitney, and Mount Whitney is higher than Mount Rainier. The obvious conclusion is that the Matterhorn is higher than Mount Rainier.

1. An **argument from definition** is an argument in which the conclusion is claimed to depend merely upon the **definition of some word or phrase used in the premise** or conclusion. For example, someone might argue that because Claudia is mendacious, it follows that she tells lies, or that because a certain paragraph is prolix, it follows that it is excessively wordy. These arguments are deductive because their conclusions follow with necessity from the definitions of ‘‘mendacious’’ and ‘‘prolix.’’ More Examples:

Cholesterol is endogenous with humans. Therefore, it is manufactured inside the human body.

Mr. Sory is a bachelor. Therefore, he is unmarried man.

1. **A syllogism**, in general, is an argument consisting of exactly two premises and one conclusion.
   1. **Categorical syllogisms** will be treated in greater depth in Chapter 5, but for now we will say that a categorical syllogism is a syllogism in which each statement begins with one of the words ‘‘all,’’ ‘‘no,’’ or ‘‘some.’’ Example:

All lasers are optical devices.

Some lasers are surgical instruments. Therefore, some optical devices are surgical instruments.

No e-mail messages are eloquent creations. Some love letters are eloquent creations. Therefore, some love letters are not e-mail messages.

Arguments such as these are nearly always best treated as deductive.

* 1. A **hypothetical syllogism** is a syllogism having a conditional statement for one or both of its premises. Examples:

If electricity flows through a conductor, then a magnetic field is produced.

If a magnetic field is produced, then a nearby compass will be deflected.

Therefore, if electricity flows through a conductor, then a nearby compass will be deflected.

If metal scratches plastic materials, then metal is harder than plastic materials.

Metal scratches plastic materials. Therefore, metal is harder than plastic materials.

Although certain forms of such arguments can sometimes be interpreted inductively, the deductive interpretation is usually the most appropriate.

* 1. A **disjunctive syllogism** is a syllogism having a disjunctive statement (i.e., an ‘‘either . . . or . . .’’ statement) for one of its premises. Example:

Either breach of contract is a crime or it is not punishable by the state.

Breach of contract is not a crime. Therefore, it is not punishable by the state.

Either classical culture originated in Greece, or it originated in Egypt. Classical culture did not originate in Egypt. Therefore, classical culture originated in Greece.

As with hypothetical syllogisms, such arguments are usually best taken as deductive.

1. Now let us consider some **typically inductive forms of argumentation**. In general, inductive arguments are such that the content of the conclusion is in some way intended to ‘‘**go beyond**’’ the content of the premises. The premises of such an argument typically deal with some subject that is relatively familiar, and the conclusion then moves beyond this to a subject that is less familiar or that little is known about. Such an argument may take any of several forms: to name just a few.
2. In a **prediction,** the premises deal with some known event in the present or past, and the conclusion moves beyond this event to some event in the relative future. For example, someone might argue that because certain meteorological phenomena have been observed to develop over a certain region of central Missouri, a storm will occur there in six hours. Or again, one might argue that because the Chinese economy has been increasing for the past ten years and it is fair this year too, it will also increase by the coming year (s). Nearly everyone realizes that the future cannot be known with certainty; thus, whenever an argument makes a prediction about the future, one is usually justified in considering the argument inductive. More Examples:

The rainfall in Seattle has been more than 15 inches every year for the past thirty years. Therefore, the rainfall next year will probably be more than 15 inches.

All observed lemons have been sour. Therefore, the next lemon to be observed will be sour

1. An **argument from analogy** is an argument that depends on the existence of an analogy, or similarity, between two things or states of affairs. Because of the existence of this analogy, a certain condition that affects the better-known thing or situation is concluded to affect the similar, lesser-known thing or situation.

For example, someone might argue that because Christina’s Porsche is a great handling car, it follows that

Angela’s Porsche must also be a great handling car.

The argument depends on the existence of a similarity, or analogy, between the two cars. The certitude attending such an inference is obviously probabilistic at best. More Examples:

The Encylopaedia Britannica has an article on symbiosis. The Encyclopedia Americana, like the Britannica, is an excellent reference work. Therefore, the Americana probably also has an article on symbiosis.

A porpoise is similar to a human being. It has lungs rather than gills. It is warm-blooded rather than cold-blooded. And porpoise nurse their young with milk. Therefore, porpoise, like humans, are capable of speaking language.

1. An **inductive generalization** is an argument that proceeds from the knowledge of a selected sample to some claim about the whole group. Because the members of the sample have a certain characteristic, it is argued that all the members of the group have that same characteristic. For example, one might argue that because three oranges selected from a certain crate were especially tasty and juicy, all the oranges from that crate are especially tasty and juicy. Or again, one might argue that because six out of a total of nine members sampled from a certain labor union intend to vote for Johnson for union president, two-thirds of the entire memberships intend to vote for Johnson. These examples illustrate the use of statistics in inductive argumentation. More Examples:

Amoco, Exxon, and Texaco are all listed on the New York Stock Exchange. It must be the case that all major American oil companies are listed on the New York Stock Exchange.

All Americans living in the US Embassy, Addis Ababa like eating pizza. Therefore, we can conclude that pizza is the favorite food for all Americans.

1. An **argument from authority** is an argument in which the conclusion rests upon a statement made by some presumed authority or witness. For example, a person might argue that earnings for Hewlett-Packard Corporation will be up in the coming quarter because of a statement to that effect by an investment counselor. Or a lawyer might argue that Mack the Knife committed the murder because an eyewitness testified to that effect under oath. Because the investment counselor and the eyewitness could be either mistaken or lying, such arguments are essentially probabilistic. More Examples:

[Psychologists] Wirtshafter and Davis noted that the glycerol content of the blood is related to the size of the fat cells [in the body]. Since the size of the fat cells would indicate something about the amount of stored fats, increases in blood glycerol should indicate increases in body weight.

World-renowned physicist Stephen Hawking says that the condition of the universe at the instant of the Big Bang was more, highly ordered than it is today. In view of Hawking's stature in the scientific community, we should conclude that this description of the universe is correct.

1. An **argument based on signs** is an argument that proceeds from the knowledge of a certain sign to knowledge of the thing or situation that the sign symbolizes. For example, when driving on an unfamiliar highway one might see a sign indicating that the road makes several sharp turns one mile ahead. Based on this information, one might argue that the road does indeed make several sharp turns one mile ahead.

Because the sign might be misplaced or in error about the turns, the conclusion is only probable. More Examples:

The plaque on the leaning tower of Pisa says that Galileo performed experiments there with falling objects. It must be the case that Galileo did indeed perform those experiments there.

The grave marker at Arlington National Cemetery says that John E Kennedy is buried there. It must be the case that Kennedy really is buried in that cemetery.

1. A **causal inference** underlies arguments that proceed from knowledge of a cause to knowledge of the effect, or, conversely, from knowledge of an effect to knowledge of a cause. For example, from the knowledge that a bottle of wine had been accidentally left in the freezer overnight, someone might conclude that it had frozen (cause to effect). Conversely, after tasting a piece of chicken and finding it dry and crunchy, one might conclude that it had been overcooked (effect to cause). Because specific instances of cause and effect can never be known with absolute certainty, one may usually interpret such arguments as inductive. More Examples:

Although both front and rear doors were found open after the burglary, there were pry marks around the lock on the rear door and deposits of mud near the threshold. It must be the case that the thief entered through the rear door and left through the front.

Crater Lake, the deepest lake in the United States, was caused by a huge volcanic eruption 7700 years ago. Since human beings have lived around the mountain for more than 10,000 years, it is likely that people witnessed that eruption.

It should be noted that the various subspecies of inductive arguments listed here are not intended to be mutually exclusive. Overlaps can and do occur. For example, many causal inferences that proceed from cause to effect also qualify as predictions.

The purpose of this survey is not to demarcate in precise terms the various forms of induction but rather to provide guidelines for distinguishing induction from deduction. Keeping this in mind, we should take care not to confuse arguments in geometry, which are always deductive, with arguments from analogy or inductive generalizations. **For example**, an argument concluding that a triangle has a certain attribute (such as a right angle) because another triangle, with which it is congruent, also has that attribute might be mistaken for an argument from analogy. Similarly, an argument that concludes that all triangles have a certain attribute (such as angles totaling two right angles) because any particular triangle has that attribute might be mistaken for an inductive generalization. Arguments such as these, however, are always deductive, because the conclusion follows necessarily and with complete certainty from the premises.

One broad classification of arguments not listed in this survey is scientific arguments. Arguments that occur in science can be either inductive or deductive, depending on the circumstances. In general, arguments aimed at the *discovery* of a law of nature are usually considered inductive. Suppose, for example, that we want to discover a law that governs the time required for a falling body to strike the earth. We drop bodies of various weights from various heights and measure the time it takes them to fall. Comparing our measurements, we notice that the time is approximately proportional to the square root of the distance. From this we conclude that the time required for anybody to fall is proportional to the square root of the distance through which it falls. Such an argument is best interpreted as an inductive generalization.

Another type of argument that occurs in science has to do with the *application* of known laws to specific circumstances. Arguments of this sort are often considered to be deductive—but only with certain reservations. Suppose, for example, that we want to apply Boyle’s law for ideal gases to a container of gas in our laboratory. Boyle’s law states that the pressure exerted by a gas on the walls of its container is inversely proportional to the volume. Applying this law, we conclude that when we reduce the volume of our laboratory sample by half, we will double the pressure. Considered purely as a mathematical computation, this argument is deductive. But if we acknowledge the fact that the conclusion pertains to the future and the possibility that Boyle’s law may not work in the future, then the argument is best considered inductive.

A final point needs to be made about the distinction between inductive and deductive arguments. There is a tradition extending back to the time of Aristotle which holds that inductive arguments are those that proceed from the particular to the general, while deductive arguments are those that proceed from the general to the particular.

(A **particular statement** is one that makes a claim about one or more particular members of a class, while a **general statement** makes a claim about *all* the members of a class.) It is true, of course, that many inductive and deductive arguments do work in this way; but this fact should not be used as a criterion for distinguishing induction from deduction. As a matter of fact, there are deductive arguments that proceed from the general to the general, from the particular to the particular, and from the particular to the general, as well as from the general to the particular; and there are inductive arguments that do the same. For example, here is a deductive argument that proceeds from the particular to the general:

Three is a prime number.

Five is a prime number.

Seven is a prime number.

Therefore, all odd numbers between two and eight are prime numbers.

And here is one that proceeds from the particular to the particular:

Gabriel is a wolf.

Gabriel has a tail.

Therefore, Gabriel’s tail is the tail of a wolf.

Here is an inductive argument that proceeds from the general to the particular:

All emeralds previously found have been green.

Therefore, the next emerald to be found will be green.

The other varieties are easy to construct. Thus, the progression from particular to general, and vice versa, cannot be used as a criterion for distinguishing induction from deduction.

In summary, to distinguish deductive arguments from inductive, we look for special indicator words, the actual strength of the inferential link between premises and conclusion, and the character or form of argumentation. If the conclusion follows with strict necessity from the premises, the argument is always deductive; if not, it could be either deductive or inductive depending on the other factors.

**1.4 Validity, Truth, Soundness, Strength, Cogency**

This section introduces the central ideas and terminology required to evaluate arguments. We have seen that every argument makes two basic claims: a claim that evidence or reasons exist and a claim that the alleged evidence or reasons support something (or that something follows from the alleged evidence or reasons). The first is a factual claim, and the second is an inferential claim. The evaluation of every argument centers on the evaluation of these two claims. The most important of the two is the inferential claim, because if the premises fail to support the conclusion (that is, if the reasoning is bad), an argument is worthless. Thus we will always test the inferential claim first, and only if the premises do support the conclusion will we test the factual claim (that is, the claim that the premises present genuine evidence, or are true). The material that follows considers first deductive arguments and then inductive.

**Deductive Arguments**

The previous section defined a deductive argument as one in which the premises are claimed to support the conclusion in such a way that it is impossible for the premises to be true and the conclusion false. If the premises do in fact support the conclusion in this way, the argument is said to be valid.

Thus, a **valid deductive argument** is an argument such that it is impossible for the premises to be true and the conclusion false. In these arguments the conclusion follows with strict necessity from the premises.

Conversely, an **invalid deductive argument** is a deductive argument such that it *is* possible for the premises to be true and the conclusion false. In invalid arguments the conclusion does not follow with strict necessity from the premises, even though it is claimed to.

An immediate consequence of these definitions is that there is no middle ground between valid and invalid. There are no arguments that are ‘‘almost’’ valid and ‘‘almost’’ invalid. If the conclusion follows with strict necessity from the premises, the argument is valid; if not, it is invalid.

To test an argument for validity we begin by assuming that all premises are true, and then we determine if it is possible, in light of that assumption, for the conclusion to be false. Here is an example:

All television networks are media companies.

NBC is a television network.

Therefore, NBC is a media company.

In this argument both premises are actually true, so it is easy to *assume* that they are true. Next we determine, in light of this assumption, if it is possible for the conclusion to be false. Clearly this is not possible. If NBC is included in the group of television networks (second premise) and if the group of television networks is included in the group of media companies (first premise), it necessarily follows that NBC is included in the group of media companies (conclusion). In other words, assuming the premises true and the conclusion false entails a strict *contradiction.* Thus the argument is valid. Here is another example:

All automakers are computer manufacturers.

United Airlines is an automaker.

Therefore, United Airlines is a computer manufacturer.

In this argument, both premises are actually false, but it is easy to assume that they are true. Every automaker could have a corporate division that manufactures computers. Also, in addition to flying airplanes, United Airlines could make cars. Next, in light of these assumptions, we determine if it is possible for the conclusion to be false. Again, we see that this is not possible, by the same reasoning as the previous example. Assuming the premises true and the conclusion false entails a contradiction. Thus, the argument is valid.

Another example:

All banks are financial institutions.

Wells Fargo is a financial institution.

Therefore, Wells Fargo is a bank.

As in the first example, both premises of this argument are true, so it is easy to assume they are true. Next we determine, in light of this assumption, if it is possible for the conclusion to be false. In this case it *is* possible. If banks were included in one part of the group of financial institutions and Wells Fargo were included in another part, then Wells Fargo would *not* be a bank. In other words, assuming the premises true and the conclusion false does not involve any contradiction, and so the argument is invalid.

In addition to illustrating the basic idea of validity, these examples suggest an important point about validity and truth. In general, validity is not something that is determined by the actual truth or falsity of the premises and conclusion. Both the NBC example and theWells Fargo example have actually true premises and an actually true conclusion, yet one is valid and the other invalid. The United Airlines example has actually false premises and an actually false conclusion, yet the argument is valid.

Rather, validity is something that is determined by the *relationship* between premises and conclusion. The question is not whether premises and conclusion are true or false, but whether the premises *support* the conclusion. In the examples of valid arguments the premises do support the conclusion, and in the invalid case they do not.

Nevertheless, there is *one* arrangement of truth and falsity in the premises and conclusion that does determine the issue of validity. Any deductive argument having actually true premises and an actually false conclusion is invalid. The reasoning behind this fact is fairly obvious. If the premises are actually true and the conclusion is actually false, then it certainly is *possible* for the premises to be true and the conclusion false. Thus, by the definition of invalidity, the argument is invalid.

The idea that any deductive argument having actually true premises and a false conclusion is invalid may be the most important point in all of deductive logic. The entire system of deductive logic would be quite useless if it accepted as valid any inferential process by which a person could start with truth in the premises and arrive at falsity in the conclusion.

Table 1.1 presents examples of deductive arguments that illustrate the various combinations of truth and falsity in the premises and conclusion. In the examples having false premises, both premises are false, but it is easy to construct other examples having only one false premise. When examining this table, note that the only combination of truth and falsity that does not allow for *both* valid and invalid arguments is true premises and false conclusion. As we have just seen, any argument having this combination is necessarily invalid.

|  |  |  |
| --- | --- | --- |
| **Deductive Arguments** | **Valid** | **Invalid** |
| **True**  **premises**  **True**  **conclusion** | All wines are beverages. Chardonnay is a wine. Therefore, chardonnay is a beverage. [sound] | All wines are beverages.  Chardonnay is a beverage.  Therefore, chardonnay is a wine. [unsound] |
| **True premises**  **False**  **conclusion** | None exist. | All wines are beverages.  Ginger ale is a beverage.  Therefore, ginger ale is a wine. [unsound] |
| **False**  **premises**  **True**  **conclusion** | All wines are soft drinks. Ginger ale is a wine. Therefore, ginger ale is a soft drink. [unsound] | All wines are whiskeys.  Chardonnay is a whiskey.  Therefore, chardonnay is a wine. [unsound] |
| **False premises**  **False**  **conclusion** | All wines are whiskeys. Ginger ale is a wine. Therefore, ginger ale is a whiskey. [unsound] | All wines are whiskeys.  Ginger ale is a whiskey.  Therefore, ginger ale is a wine. [unsound] |

The relationship between the validity of a deductive argument and the truth or falsity of its premises and conclusion, as illustrated in Table 1.1, is summarized as follows:

|  |  |  |
| --- | --- | --- |
| **Premises** | **Conclusion** | **Validity** |
| T | T | Valid or invalid |
| T | F | Invalid |
| F | T | Valid or invalid |
| F | F | Valid or invalid |

A **sound argument** is a deductive argument that is *valid* and has *all true premises.*

Both conditions must be met for an argument to be sound, and if either is missing the argument is unsound. Thus, an unsound argument is a deductive argument that is invalid, has one or more false premises, or both. Because a valid argument is one such that it is impossible for the premises to be true and the conclusion false, and because a sound argument does in fact have true premises, it follows that every sound argument, by definition, will have a true conclusion as well. A sound argument, therefore, is what is meant by a ‘‘good’’ deductive argument in the fullest sense of the term.

Sound argument = Valid argument + All true premise

In connection with this definition of soundness, a single proviso is required: For an argument to be unsound, the false premise or premises must actually be needed to support the conclusion. An argument with a conclusion that is validly supported by true premises but with a superfluous false premise would still be sound. Analogous remarks, incidentally, extend to induction.

**Inductive Arguments**

Section 1.3 defined an inductive argument as one in which the premises are claimed to support the conclusion in such a way that it is improbable that the premises be true and the conclusion false. If the premises do in fact support the conclusion in this way, the argument is said to be strong. Thus, a **strong inductive argument** is an inductive argument such that it is improbable that the premises be true and the conclusion false.

In such arguments, the conclusion follows probably from the premises. Conversely, a **weak inductive argument** is an inductive argument such that the conclusion does not follow probably from the premises, even though it is claimed to.

The procedure for testing the strength of inductive arguments runs parallel to the procedure for deduction. First we assume the premises are true, and then we determine whether, based on that assumption, the conclusion is probably true. Example:

All dinosaur bones discovered to this day have been at least 50 million years old.

Therefore, probably the next dinosaur bone to be found will be at least 50 million years old.

In this argument the premise is actually true, so it is easy to assume that it is true. Based on that assumption, the conclusion is probably true, so the argument is strong.

Here is another example:

All meteorites found to this day have contained gold. Therefore, probably the next meteorite to be found will contain gold.

The premise of this argument is actually false. Few, if any, meteorites contain any gold. But if we assume the premise is true, then based on that assumption, the conclusion would probably be true. Thus, the argument is strong.

The next example is an argument from analogy:

When a lighted match is slowly dunked into water, the flame is snuffed out.

But gasoline is a liquid, just like water.

Therefore, when a lighted match is slowly dunked into gasoline, the flame will be snuffed out.

In this argument the premises are actually true and the conclusion is probably false. Thus, if we assume the premises are true, then, based on that assumption, it is not probable that the conclusion is true. Thus, the argument is weak. Another example:

During the past fifty years, inflation has consistently reduced the value of the American dollar. Therefore, industrial productivity will probably increase in the years ahead.

In this argument, the premise is actually true and the conclusion is probably true in the actual world, but the probability of the conclusion is in no way based on the assumption that the premise is true. Because there is no direct connection between inflation and increased industrial productivity, the premise is irrelevant to the conclusion and it provides no probabilistic support for it. The conclusion is probably true independently of the premise. As a result, the argument is weak.

This last example illustrates an important distinction between strong inductive arguments and valid deductive arguments. As we will see in later chapters, if the conclusion of a deductive argument is necessarily true independently of the premises, the argument will still be considered valid. But if the conclusion of an inductive argument is probably true independently of the premises, the argument will be weak. These four examples show that in general the strength or weakness of an inductive argument results not from the actual truth or falsity of the premises and conclusion, but from the probabilistic support the premises give to the conclusion. The dinosaur argument has a true premise and probably true conclusion, and the meteorite argument has a false premise and a probably false conclusion; yet, both are strong because the premise of each provides probabilistic support for the conclusion. The industrial productivity argument has a true premise and a probably true conclusion, but the argument is weak because the premise provides no probabilistic support for the conclusion.

Analogously to the evaluation of deductive arguments, the only arrangement of truth and falsity that establishes anything is true premises and probably false conclusion (as in the lighted match argument). Any inductive argument having true premises and a probably false conclusion is weak.

Table 1.2 presents the various possibilities of truth and falsity in the premises and conclusion of inductive arguments. Note that the only arrangement of truth and falsity that is missing for strong arguments is true premises and probably false conclusion. The relationship between the strength of an inductive argument and the truth or falsity of its premises and conclusion, as illustrated in Table 1.2, is summarized as follows:

|  |  |  |
| --- | --- | --- |
| **Premises** | **Conclusion** | **Validity** |
| T | T | strong or weak |
| T | F | weak |
| T | F | strong or weak |
| F | F | strong or weak |

|  |  |  |
| --- | --- | --- |
| **Inductive Arguments** | **Strong** | **Weak** |
| **True premise Probably true conclusion** | All previous U.S. presidents were older than 40.  Therefore, probably the next U.S. president will be older than 40. [cogent] | A few U.S. presidents were lawyers.  Therefore, probably the next U.S. president will be older than 40. [uncogent] | |
| **True premise Probably false conclusion** | None exist | A few U.S. presidents were unmarried.  Therefore, probably the next U.S. president will be unmarried [uncogent] | |
| **False premise Probably true conclusion** | All previous U.S. presidents were TV debaters.  Therefore, probably the next U.S. president will be a TV debater. [uncogent] | A few U.S. presidents were dentists.  Therefore, probably the next U.S. president will be a TV debater. [uncogent] | |
| **False premise Probably false conclusion** | All previous U.S. presidents died in office.  Therefore, probably the next U.S. president will die in office. [uncogent] | A few U.S. presidents were dentists.  Therefore, probably the next U.S. president will be a dentist. [uncogent] | |

Unlike the validity and invalidity of deductive arguments, the strength and weakness of inductive arguments admit of degrees. To be considered strong, an inductive argument must have a conclusion that is more probable than improbable. In other words, the likelihood that the conclusion is true must be more than 50 percent, and as the probability increases, the argument becomes stronger. For this purpose, consider the following pair of arguments:

This barrel contains 100 apples.

Three apples selected at random were found to be ripe.

Therefore, probably all 100 apples are ripe.

This barrel contains 100 apples.

Eighty apples selected at random were found to be ripe.

Therefore, probably all 100 apples are ripe.

The first argument is weak and the second is strong. However, the first is not absolutely weak nor the second absolutely strong. Both arguments would be strengthened or weakened by the random selection of a larger or smaller sample. For example, if the size of the sample in the second argument were reduced to 70 apples, the argument would be weakened. The incorporation of additional premises into an inductive argument will also generally tend to strengthen or weaken it. For example, if the premise ‘‘One unripe apple that had been found earlier was removed’’ were added to either argument, the argument would be weakened.

A **cogent argument** is an inductive argument that is *strong* and has *all true premises;* if either condition is missing, the argument is uncogent. Thus, an uncogent argumentis an inductive argument that is weak, has one or more false premises, or both.

A cogent argument is the inductive analogue of a sound deductive argument and is what is meant by a ‘‘good’’ inductive argument without qualification. Because theconclusion of a cogent argument is genuinely supported by true premises, it followsthat the conclusion of every cogent argument is probably true.

Cogent argument= Strong argument + All true premises

There is a difference, however, between sound and cogent arguments in regard to the true-premise requirement. In a sound argument it is only necessary that the premises be true and nothing more. Given such premises and good reasoning, a true conclusion is guaranteed. In a cogent argument, on the other hand, the premises must not only be true, they must also not ignore some important piece of evidence that outweighs the given evidence and entails a quite different conclusion. As an illustration of this point, consider the following argument:

Swimming in the Caribbean is usually lots of fun. Today the water is warm, the surf is gentle, and on this beach there are no dangerous currents. Therefore, it would be fun to go swimming here now.

If the premises reflect all the important factors, then the argument is cogent. But if they ignore the fact that several large dorsal fins are cutting through the water, then obviously the argument is not cogent. Thus, for cogency the premises must not only be true but also not overlook some important factor that outweighs the given evidence and requires a different conclusion.

In summary, for both deductive and inductive arguments, two separate questions need to be answered: (1) Do the premises support the conclusion? (2) Are all the premises true?

To answer the first question we begin by *assuming* the premises to be true. Then, for deductive arguments we determine whether, in light of this assumption, it *necessarily* follows that the conclusion is true. If it does, the argument is valid; if not, it is invalid. For inductive arguments we determine whether it *probably* follows that the conclusion is true. If it does, the argument is strong; if not, it is weak. For inductive arguments we keep in mind the requirements that the premises actually support the conclusion and that they not ignore important evidence. Finally, if the argument is either valid or strong, we turn to the second question and determine whether the premises are actually true. If all the premises are true, the argument is sound (in the case of deduction) or cogent (in the case of induction). All invalid deductive arguments are unsound, and all weak inductive arguments are uncogent.

The various alternatives open to statements and arguments may be diagrammed as follows. Note that in logic one never speaks of an argument as being ‘‘true’’ or ‘‘false,’’ and one never speaks of a statement as being ‘‘valid,’’ ‘‘invalid,’’ ‘‘strong,’’ or ‘‘weak.’’ Statements is evaluated as True or False

**Exercises are canceled. Please read it from the book!**

**1.5: Argument Forms: Proving Invalidity**

The previous section showed that validity is determined by the truth of a deductive argument’s inferential claim. If the inferential claim is true, then the conclusion follows with strict necessity from the premises, and the argument is valid. For such an argument, it is impossible for the premises to be true and the conclusion false.

This section shows that the truth of a deductive argument’s inferential claim (that is, the correctness of the argument’s reasoning) is determined by the form of the argument. In other words, validity is determined by form. For these purposes, consider the following argument:

All adlers are bobkins.

All bobkins are crockers.

Therefore, all adlers are crockers.

Because the words ‘‘adlers,’’ ‘‘bobkins,’’ and ‘‘crockers’’ are nonsensical, we do not know whether any of the statements in this argument are true or false. Yet, we do know that if we *assume* that the premises are true, it is impossible for the conclusion to be false. That is, if we assume that the adlers, whatever they might be, are included in the bobkins and the bobkins in the crockers, then we must accept the conclusion that the adlers are included in the crockers. According to the definition of validity, therefore, the argument is valid.

This fact is important for understanding the nature of validity because it shows that the validity of an argument has nothing to do with its specific subject matter. Even though we know nothing about adlers, bobkins, and crockers, we still know that the argument is valid. The validity of the argument arises from the way the terms ‘‘adlers,’’ ‘‘bobkins,’’ and ‘‘crockers’’ are arranged in the statements. If we represent these terms by their first letters, we obtain the following *argument form.*We use a line to separate the premises from the conclusion.

All *A* are *B.*

All *B* are *C.*

All *A* are *C.*

This is a valid argument form. Its validity rests purely upon the arrangement of the letters within the statements, and it has nothing to do with what the letters might stand for. In light of this fact, we can substitute any terms we choose in place of *A, B,* and *C,* and as long as we are consistent, we will obtain a valid argument. For example, we might substitute ‘‘daisies’’ for *A,* ‘‘flowers’’ for *B,* and ‘‘plants’’ for *C* and obtain the following valid argument:

All daisies are flowers.

All flowers are plants.

Therefore, all daisies are plants.

Any argument, such as this, that is produced by uniformly substituting terms or statements in place of the letters in an argument form is called a **substitution instance** of that form.

Let us turn now to the concept of invalidity. Consider the following argument:

All adlers are bobkins.

All crockers are bobkins.

Therefore, all adlers are crockers.

As with the previous argument, we do not know whether the premises and conclusion of this argument are true or false. But if we assume that the premises are true, it is *possible* for the conclusion to be false. It might be the case, for example, that the adlers make up one part of the bobkins, that the crockers make up another part, and that the adlers and the crockers are completely separate from each other. In this case the premises would be true and the conclusion false. The argument is therefore invalid. If we represent the terms in this argument by their first letters, we obtain the following argument form:

All *A* are *B.*

All *C* are *B.*

All *A* are *C.*

This is an invalid form, and any argument that has this form is an invalid argument. An argument is said to *have* a certain form if it is a substitution instance of that form. In the case of invalid forms, we must add the proviso that an argument has an invalid form only if it is not a substitution instance of any valid form.\* The following argument is a substitution instance of the invalid form just discussed and it is not a substitution instance of any valid form. Thus, the following argument has the invalid form just discussed:

All cats are animals.

All dogs are animals.

Therefore, all cats are dogs.

\*The reason for this proviso is that some substitution instances of invalid forms are actually valid.

Example:

All bachelors are persons.

All unmarried men are persons.

Therefore, all bachelors are unmarried men.

This argument is a substitution instance of the invalid form discussed above, but the argument is valid because its conclusion is true by definition. However, because ‘‘bachelors’’ is equivalent in meaning to ‘‘unmarried men,’’ the argument is also a substitution instance of the valid form

All *A* are *B.*

All *A* are *B.*

All *A* are *A.*

Thus, by the stated proviso, the bachelors’ argument does not have the invalid form in question but rather has this valid form. The exercises in this book avoid examples of this sort, where the form of the argument is obscured by the meaning of the terms.

Notice that this substitution instance has true premises and a false conclusion. It is therefore clearly invalid, and it constitutes proof that the original argument is invalid. The reasoning behind this proof is as follows. The substitution instance is invalid because it has true premises and a false conclusion. Therefore, the substitution instance has an invalid form. But the form of the substitution instance is identical to the form of the (second) adler-bobkin argument. Therefore, the adler-bobkin argument is invalid.

A substitution instance having true premises and a false conclusion is called a counterexample, and the method we have just used to prove the adler-bobkin argument invalid is called the **counterexample method.** The counterexample method can be used to establish the invalidity of any invalid argument, but it cannot establish the validity of any valid argument. Thus, before the method is applied to an argument, the argument must be known or suspected to be invalid in the first place. The counterexample method consists in isolating the form of the argument and then constructing a substitution instance having true premises and a false conclusion. Let us apply it to the following invalid categorical syllogism:

Since some employees are not social climbers and all vice-presidents are employees, we may conclude that some vice-presidents are not social climbers.

This argument is invalid because the employees who are not social climbers might not be vice-presidents. Accordingly, we can *prove* the argument invalid by constructing a substitution instance having true premises and a false conclusion. We begin by isolating the form of the argument:

Some *E* are not *S*.

All *V* are *E*.

Some *V* are not *S*.

Next, we select three terms to substitute in place of the letters that will make the premises true and the conclusion false. The following selection will work:

*E* \_ animals

*S* \_ mammals

*V* \_ dogs

The resulting substitution instance is:

Some animals are not mammals.

All dogs are animals.

Therefore, some dogs are not mammals.

The substitution instance has true premises and a false conclusion and is therefore, by definition, invalid. Since it has the same form as the original argument, it constitutes proof that the original argument is invalid.

In applying the counterexample method to categorical syllogisms, it is useful to keep in mind the following set of terms: ‘‘cats,’’ ‘‘dogs,’’ ‘‘mammals,’’ ‘‘fish,’’ and ‘‘animals.’’ Most invalid syllogisms can be proven invalid by strategically selecting three of these terms and using them to construct a counterexample. Because everyone agrees about these terms, everyone will agree about the truth or falsity of the premises and conclusion of the counterexample. Also, in constructing the counterexample, it often helps to begin with the conclusion. First, select two terms that yield a false conclusion, and then select a third term that yields true premises. Another point to keep in mind is that the word ‘‘some’’ in logic always means ‘‘at least one.’’ For example, the statement ‘‘Some dogs are animals’’ means ‘‘At least one dog is an animal’’—which is true. Also note that this statement does not imply that some dogs are not animals.

Not all deductive arguments, of course, are categorical syllogisms. Consider, for example, the following hypothetical syllogism:

If the government imposes import restrictions, the price of automobiles will rise.

Therefore, since the government will not impose import restrictions,

It follows that the price of automobiles will not rise.

This argument is invalid because the price of automobiles might rise even though import restrictions are not imposed. It has the following form:

If *G,* then *P.*

Not *G.*

Not *P.*

This form differs from the previous one in that its letters stand for complete statements. *G,* for example, stands for ‘‘The government imposes import restrictions (’’ If we make the substitution *G* \_ Abraham Lincoln committed suicide\_ Abraham Lincoln is dead) we obtain the following substitution instance:

If Abraham Lincoln committed suicide, then Abraham Lincoln is dead.

Abraham Lincoln did not commit suicide.

Therefore, Abraham Lincoln is not dead.

Since the premises are true and the conclusion false, the substitution instance is clearly invalid. Thus, it constitutes proof that the original argument is invalid. When applying the counterexample method to an argument having a conditional statement as a premise (such as the one above), it is recommended that the statement substituted in place of the conditional statement express some kind of necessary connection. In the Lincoln example, the first premise asserts the necessary connection between suicide and death. There can be no doubt about the truth of such a statement.

Furthermore, if it should turn out that the conclusion is a conditional statement, note that one sure way of producing a false conditional statement is by joining a true antecedent with a false consequent. For example, the conditional statement ‘‘If Lassie is a dog, then Lassie is a cat’’ is clearly false. Being able to identify the form of an argument with ease requires a familiarity with the basic deductive argument forms. The first task consists in distinguishing the premises from the conclusion. Always write the premises first and the conclusion last. The second task involves distinguishing what we may call ‘‘form words’’ from ‘‘content words.’’ To reduce an argument to its form, leave the form words as they are, and replace the content words with letters. For categorical syllogisms, the words ‘‘all,’’ ‘‘no,’’ ‘‘some,’’ ‘‘are,’’ and ‘‘not’’ are form words, and for hypothetical syllogisms the words ‘‘if,’’ ‘‘then,’’ and ‘‘not’’ are form words. Additional form words for other types of arguments are ‘‘either,’’ ‘‘or,’’ ‘‘both,’’ and ‘‘and.’’ For various kinds of hybrid arguments, a more intuitive approach may be needed. Here is an example:

All movie stars are actors who are famous, because all movie stars who are famous are actors.

If we replace ‘‘movie stars,’’ ‘‘actors,’’ and ‘‘famous’’ with the letters *M, A,* and *F,* this argument has the following form:

All *M* who are *F* are *A.*

All *M* are *A* who are *F.*

Here is one possible substitution instance for this form:

All humans who are fathers are men.

Therefore, all humans are men who are fathers.

Because the premise is true and the conclusion false, the argument is invalid. Using the counterexample method to prove arguments invalid requires a little ingenuity because there is no rule that will automatically produce the required term or statement to be substituted. Any term or statement will work, of course, provided that it yields a substitution instance that has premises that are indisputably true and a conclusion that is indisputably false. Ideally, the truth value of these statements should be known to the average individual; otherwise, the substitution instance cannot be depended upon to prove anything. If, for example, *P* in the earlier hypothetical syllogism had been replaced by the statement ‘‘George Wilson is dead,’’ the substitution instance would be useless, because nobody knows whether this statement is true or false.

The counterexample method is useful only for proving invalidity, because the only arrangement of truth and falsity that proves anything is true premises and false conclusion. If a substitution instance is produced having true premises and a true conclusion, it does *not* prove that the argument is valid. Furthermore, the method is only useful for deductive arguments because the strength and weakness of inductive arguments is only partially dependent on the form of the argument. Accordingly, no method that relates exclusively to the form of an inductive argument can be used to prove the argument weak.

One final comment is needed regarding the form of an argument. It often happens that the form is not explicit and that making it explicit requires an analysis of the meaning of the language. Many of the arguments in Exercise 1.4 were of this sort.

Consider the following example:

This figure is a square.

Therefore, this figure has four sides.

The conclusion follows necessarily from the premise because every square, by definition, has four sides. To make the form of the argument explicit, a premise must be added stating this fact:

This figure is a square.

All squares have four sides.

Therefore, this figure has four sides.

As this example illustrates the statement at the beginning of this section that the validity of an argument is concerned not with the subject matter but rather with the form of an argument needs qualification. When the form of an argument is immediately clear, the subject matter is irrelevant to the question of validity. But when the form is not clear, the subject matter may have to be analyzed to determine what the form is.