CHAPTER TWO: Basic Concepts of Logic

Introduction

Logic is the study of the methods and principles used to distinguish good (correct) from bad (incorrect) arguments. This chapter provides students with some preliminary notions and guidelines about logic as a subject matter. Moreover, the chapter deals with; the nature of arguments and their components (premises and conclusion), deductive and inductive arguments, validity, truth, soundness, strength, cogency, argument forms and proving validity.

What is Logic?

Everyone thinks, every one reasons, every one argues, and everyone is subjected to the reasoning and arguments of others. We are daily bombarded with reasoning from many sources: books, speeches, radio, TV, newspapers, employers, friends and family…. Some people think well, and argue well. Some do not. The ability to think, reason and argue well is partly a matter of natural gifts. But whatever our natural gifts, they can be refined and sharpened. And, the study of logic is one of the best ways to refine one's natural ability to reason and argue. Through the study of logic, one learns strategies for thinking well, common errors in reasoning to avoid, and effective techniques for evaluating arguments

As it has been underlined in the above passage, logic is a discipline of philosophy which is basically concerned with the formulation of principles which correct our reasoning processes. The principles formulated in logic are guiding procedures so as to evaluate argument forms, which are the fundamentals of the subject matter.

An argument, which is primary focus of logic in coming sections, is a group of statements containing a conclusion that is affirmed on the bases of what are called premises.

As it has been stated before, arguments are familiar in our day-to-day communications and experiences with different parties in the sense that they are available in text books, news papers, debates and in different modes of communication among individuals or groups. Thus, logic is aimed at designing methods and principles in order to evaluate arguments which can be conducted by different parts of a given society.

Finally, the principles of logic enable us to develop our confidence in critically and rationally evaluating others' arguments and to construct our own persuasive and logical forms of speech.

The Nature of Arguments

1.5.1 Argument; Premises and conclusion

An argument, which is the primary focus of logic, is a group of statements, which composes premise(s) and a conclusion. A premise (which can be one or more than one) is a statement, which provides reason or support for the conclusion. And, a conclusion (which is always one) of an argument is a statement, which is claimed to be supported or implied. And, arguments which the premises really supports the conclusion are good arguments and those which are on the contrary are bad arguments. Here, logic sets methods, principles and techniques, which enable us to differentiate good arguments from bad ones.

As it has been stated before, the term 'argument', unlike its ordinary meaning as a mere verbal fight between or among different individuals, has a completely different meaning. An argument is composed of statements, which have truth-values and logically

interconnected ideas as premises and conclusion. In other words, an argument is composed of statements as premises and conclusion to which they are evaluated either true or false as they are declarative sentences. Here, sentences which contain questions, proposals, suggestions, commands, exclamations and the like cannot be considered as statements as they cannot have truth values.

In some cases, however, a statement can also be expressed in a form of rhetorical questions. For instance, the premise of the following legal argument is expressed in interrogative form.

If the criminal law forbids suicide, that is not an argument valid in the church; and besides, the prohibition is ridiculous; for what penalty can frighten a person who is not afraid of death itself?

It is now clear that an argument is composed of premises and a conclusion that the latter is the statement that is claimed to follow from the former. Here our central task is to distinguish premise(s) from the conclusion within an argument. The first strategy to accomplish this task is by using **indicator words**. This is to say that there are some typical **conclusion indicator** words and some other **premise indicator** words. Thus, based on those premise and conclusion indicator words, one can easily distinguish premises form the conclusion. For that matter, some of the typical **conclusion indicators** are the followings:-

- Thus	- so	- For this reason
- Wherefore	- hence	- it follows that
- Therefore	- accordingly	- as a result
- Consequently	- it must be that	- implies that…

Example: A Federal government usually possesses a constitution, which guarantees power sharing between the federal/central government and those regional/ local governments. This implies that distribution of power is the silent feature of any federal government.

The statement before the words '*implies that'* is the premise and the statement that follows/contains 'implies that' is the conclusion of the argument given above.

And, some of the typical **premise indicator** words are the followings:

- Since - as indicated by
- Because - in that
- For - may be inferred from
- As - given that….

Example:-

The constitution of a state does not narrate details of laws as it simply gives general guidelines which all other laws are in accordance with.

The statement before the word '*as'* is the conclusion where as that of after '*as'* is the premise of the above argument. The other important point that should be underlined is that indicator words (Premise as well as conclusion indicators) are not always guarantees to distinguish or show premise (s) from conclusion of a given argument because of two important reasons:

a. There might be cases where there are not indicator words in passages which contain argument.

b. Though they exist, they might have some other purposes (explanation, illustration…) other than showing argumentation accompanied by premises and conclusion.

As to the problem stated in (a) One can end up with successful solution by responding to ant of the following questions:

- Which statement is claimed to follow from others?
- What is the arguer trying to arrive at /prove? Or
- What is the main point of the passage?

And, the answer to these questions points out to the conclusion of an argument so that the rest will be its premise(s). This is to say that in the absence of those indicator words, one should carefully appeal to the inferential claim (reasoning process) that the claim (s) /evidence(s) which the statement (s) hold (s) is/are considered to be premise(s) and the other statement that is to be followed is the conclusion of a given argument. For example: the following passage, which contains an argument, does not have any indicator word:

Example: *A politician who does not have the courage to political life is not destined to the discipline. Mohammed does not have any courage to it. Mohammed is not destined to political life.*

And, when we look at the inferential relationships among the above three statements of the passage, the statement "Mohammed is not destined to political life" is the statement which is intended to be proved so that it is the conclusion and the remaining two statements are premises of the above argument.

In relation to the concept of argument, **inference** and **proposition** are the two common notions. Inference is nothing but the reasoning process expressed by an argument and that of a proposition means the information content or meaning of statements, which compose an argument.

As to the problem stated in (b) that the existence of indicator words by themselves cannot always guarantee the existence of premise(s) and conclusion or an argument in a passage.

One can look the following two examples which both contain the indicator word **"since**" that it serves as **time indicator** in the first passage where as **premise indicator** in the next passage (argument):-

- *Ethiopia has a long history in constitutional traditions. And, since 1995 the country has guided by a federal constitution.* (Here **since** is used as **time indicator** and the passage in fact doesn't contain an argument as there is not any inferential claim in it).
- *Since the 1995 constitution of Ethiopia includes fundamental human and democratic rights of the people, it is relatively better than all constitutions which had been formulated before.* (Here ***since*** is used as a **premise indicator** so that the passage contains inferential claim, which in turn proves that it is an argument.

Recognizing Arguments

It has been partially clear that an argument is the primary focus of logic. But it should also be underlined that all forms of speeches as well as passages do not contain arguments. In short, any form of speech or passage is labeled as an argument if and only if it fulfills the following two conditions:

a. *A minimum of one statement must claim to provide reason or evidence,*

b. *There must be a claim tha*t *something* is *followed from the evidence.*

As it has been stated before, **premises** refer to the statements claiming to provide evidence, and **conclusion** refers to the statement that the evidence is claimed to imply or support. Here the question is: Is it necessary for the premises to be true? No, it is not mandatory that the premises provide actual or genuine support to the conclusion or it is not necessary for the premises actually support the conclusion. But the premises must claim to provide evidences or reasons; and there must be a claim that the evidences or reasons support or imply something. When we say the premises must claim to provide evidence, it suggests that the reasons or evidence presented have not proved to be true, but the assertion that it is true is there. As a result, the premises may be either true or false. It may, therefore, be either factual evidence or not.

In any case the first condition stated in (a) expresses what is called ***factual* Claim** which is not mandatory for a passage that contains an argument unlike the second condition stated in (b), which is commonly called **inferential Claim**. The inferential claim is to mean the claim that the passage expresses a reasoning process that the passage expresses a reasoning process that something supports or implies something.

Thus, the second precondition implies that the existence of an inferential claim (the claim that a passage/speech contains or expresses reasoning process) is mandatory to consider a given passage or speech as an argument- i.e. something should be implied or followed from others in any argument. And, such an inferential relationship of an argument can be expressed:-

a. Either explicitly through indicator (premise as well as conclusion indicators) words as it has been witnessed before.

Example:

Expectant Mother should never use excessive alcoholic drinks and drugs as these substances can endanger the development of the fetus.

Here the word "as" shows that there is a reasoning process being expressed in the passage.

b. Implicitly through understanding the inferential relationship between premises and the conclusion.

Example:

Freedom of press is one of the most important of our constitutionally guaranteed freedoms. Without it, other freedoms would be immediately threatened. Furthermore, it provides the fulcrum for the development of new freedoms.

There is an inferential relationship between the first and the other two sentences. Of course, this relationship constitutes an implicit claim that evidence supports something. So we are justified in calling this passage argument. And, the first statement is the conclusion and the other two are premises.

Moreover, the other alternative that enables us to differentiate passages, which contain arguments from those which do not have, is through distinguishing non-inferential passages/non argument forms with that of inferential passages/ argument forms. Based on

this guideline passages which contain **warnings, advices, a statement of belief, reports** and the like lack inferential claim that they are non-inferential passages. Thus, they are non-argument forms as some of their details is to be disclosed in the following section.

Warnings: - are cautionary advices, which save someone from any bad or dangerous incident or situation. And, such forms of speech are non-arguments as they clearly lack inferential claim.

Example: *Shut your mouth*!

Pieces of advice are forms of expression, which contain counseling or guidelines to someone to follow appropriate procedures, actions, and choices.

Example:

I advise you to improve your behavior before you graduate.

Statements of Belief and Opinion are:- is forms of expression, which are basically accompanied by somebody's beliefs, thinking, opinions as well as judgments on different events, or courses of action. But these opinions or judgments might not be supported through proofs or evidences rather than showing individual's perceptions on those events or courses of action.

Example:

In my opinion, abortion is a crime against humanity.

Loosely associated statements are: forms of expression accompanied by various statements which are mainly concerned with the same general theme, however, they are not logically connected or they lack inferential claim so that they cannot be considered as arguments.

Example:

Anything that a doctor does which requires cutting or injecting is a 'Procedure'. Anything that a doctor does which requires thinking or counseling is a "cognitive services". Procedures pay much better than cognitive services.

Reports are sets of statements, which are basically there to convey or deliver information about different events or incidents. Reporters or journalists are basically destined to deliver information about different incidents rather than arguing on them.

Example:

"*The Islamic forces in Somalia led by 'Alshebab' groups declared war to liberate Somalia from Ethiopian forces" Aljezira, 2008.*

- But there is the case when reports about arguments are delivered. In such case though the report itself is not an argument, the reported passage can be interpreted as an argument since it is accompanied by position, which is supported by evidences. However, the passage/argument in the report is not performed by the author of the report, but by those whom the author of the report is reporting.

Expository Passages (Elaborations):- are passages, which begin with topic sentences or fundamental points. And, there are additional sentences, which are

primarily there to develop or elaborate those topic sentences rather than to prove them.

Example:-

The speed of reading depends entirely upon the reader. He may read as slowly or as rapidly as he can or wishes to read. If he does not understand something, he may stop and read it, or go in search of elucidation before continuing.

But there are cases where expository passages can be counted as arguments when those elaborating sentences, other than the topic sentence, are there not only to develop topic sentence, but also to prove it.

Illustrations: - are forms of exemplifying or clarifying instances on concepts, issues or different subject matters. This is to say that when a statement about a certain issue is accompanied by different instances to exemplify it, it is considered as an illustration.

Example:

Mammals are vertebrate animals that nourish their young with milk. For example, cats, horses, goats, monkeys, and humans are mammals.

However, there are passages, which give examples, can be interpreted as arguments.

Example:

Water is an excellent solvent. It dissolves many minerals that do not readily dissolve in other liquids. For example, salts do not dissolve in most common solvent such as gasoline, kerosene, etc. But many salts dissolve readily in water.

Here this example is intended to prove that water is an excellent solvent so that it can be considered as an argument.

Thus, like expository passages, some illustrations are considered as arguments if there is an inferential relationship or reasoning process among their statements.

Conditional Statements:-

A sentence constructed through an 'if … then…" statement is a conditional statement. And, a statement that is following 'then' is called ***consequent*** and a statement following 'if' is called an ***antecedent***.

Conditional statements do not usually contain argument; rather they signify the causal connection between the antecedent and the consequent as:

- **If** antecedent, **then** consequent.
- Consequent **if** antecedent.

Example:
If you study hard, you will score a good grade, or
You will score a good grade if you study hard.

However, it is not always the case that all conditional statements express only causal connections in the sense that there are cases where conditional statements are interpreted as arguments if the connection between the two is as follows:

- A single conditional statement is not an argument.
- A conditional statement may serve as either the premise or the conclusion or both of an argument.
- The inferential content of a conditional statement may be re-expressed to form an argument.

Example:

If the earth's magnetic field disappears, then the Vann Allen radiation belt will be dissolved. The earth's magnetic field is disappeared. Therefore, the Van Allen radiation belt will be dissolved.

In this example, the conditional sentence served as the premise of an argument. Thus, if the passage consists of conditional statements together with some other statement (like the above example), then it may be an argument depending on the presence of indicator words and an inferential relationship between the premises and the conclusion.

Another important point is that conditional statements are useful in logic since they express the relationship between ***sufficient*** and **necessary conditions. '**X' is said to be a sufficient condition for 'Y' whenever the occurrence of 'X' is all that is needed for the occurrence of 'Y'. For example, it is clear that a knife could cause a scare to appear. When we put this in a conditional statement, it is as "If you are stabbed by Knife, a scare will appear in your body". Or to put this in terms of sufficient and necessary condition it can be presented as "being stabbed by a knife is a sufficient condition for the occurrence of scare." However, being stabbed by a knife is not a necessary condition for the occurrence of scare because many other things may cause scare.

'X' is said to be the necessary condition for 'Y' whenever 'Y' cannot occur without the occurrence of 'X'. For example, air is a necessary condition for life. It is a necessary condition because one cannot think of life without air. But it is not a sufficient condition since there are other necessary conditions.

An Explanation- Consists of statements or group of statements intended to shed light on some phenomenon that is usually accepted as a matter of fact.

Examples:

1. *Azeb is sick because she ate too much.*
2. *The price of oil declined because of the international financial crisis.*

In an explanation, there are two distinct components: The ***explanandum*** and the ***explanans*.** The explanandum is the statement that describes the event or phenomenon to be explained, and the explanans is a statement that does the explaining. In the first example the explanandum is the statement "Azeb is sick" and the explanans is "She ate too much".

Explanations usually contain indicator words such as "because" and others so that they may be confused with arguments. This is precisely because while in the explanation, the explanans are intended to show why something is the case, where as in an argument the premises are intended to prove that something is the case. In the above two examples, the arguers are intended to explain the situations rather than proving them.

Deductive and Inductive Arguments

Based on the kind of connection existed between the premises and the conclusion, arguments can broadly be classified in to two; **deductive** and **inductive**. And, the difference in the strength of the inferential claim or the degree of strength of the reasoning process existed between the premises and the conclusion matters most to arrive at such dichotomy between the above two categories of arguments.

Deductive arguments are arguments, which their premises guarantee the conclusion in the sense that if we assume that the premises are true, the conclusion must be true. In other words, the connection between the premises and the conclusion in any deductive argument is a matter of necessity or certainty that the conclusion in a deductive argument cannot be otherwise (false) if its premises are true.

Example – *All human beings are mortal.*
Pelle is a human being.
Therefore, Pelle is Mortal.

In this example, the premises support the conclusion with certainty so that the conclusion is inferred with ***logical necessity*** from the evidences or premises.

On the other hand, ***inductive arguments*** are those, which their premises simply suggest the conclusion that if we assume that the premises are true, the conclusion will probably be true. This implies that there is a probable connection between the premises and the conclusion of an inductive argument. Thus, the inferential link between the premises and the conclusion of any inductive argument is matter of ***likelihood or probability*** unlike that of any deductive argument.

Example:-*The majority of Ethiopian University students are seriously concerned about employment opportunity. Rahel is a University Student. Therefore, Rahel is seriously concerned about employment opportunity.*

The premise of the above argument is supporting the conclusion with the degree of likelihood or probability that there is no relationship of logical necessity between the premise and the conclusion.

There are cases where inductive arguments are understood, as arguments, which reason from **part to whole** and deductive argument, are those, which reason from **whole to part**. However, this kind of approach does not always work. And, the following two examples show that the above definitions do not always work.

Example 1:
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.

- This is reasoning from particular to general, however the argument is deductive.

Example 2:

All the last experiences in Ethiopian politics have shown that political power is not secured through unconstitutional means. Therefore, Political power in Ethiopia will be secured through similar strategy in the coming years.

- This is an inductive argument since it seems to argue to forecast the future based on past experiences.

In any case, the strength of the inferential connection between the premises and the conclusion should be taken as an indispensable criterion to differentiate or show the distinction between inductive and deductive arguments.

To sum up there are three criteria, which are important to distinguish inductive arguments from deductive arguments. These are:

A. ***The existence of indicator words*** such as **necessarily, certainly, absolutely**, and **definitely** in arguments show that such arguments are deductive. And the existence words such as **likely, probably, unlikely, plausibly** in arguments shows that such arguments are inductive. But, these deductive and inductive indicator words cannot always show the distinction between the two argument forms so that it is mandatory to appeal to other criteria.

B. ***The actual strength of the inferential link between the premises and the conclusion of a given argument*** is another criterion to distinguish deductive from an inductive argument. If the conclusion is **strictly or logically** followed form the premises, the argument will be deductive but if the conclusion is **probably** followed from the premises, the argument is inductive.

C. Typical deductive and inductive argument forms

Deductive argument forms

- **Mathematical argumentations** are deductive argument forms since they are accompanied by some arithmetic and geometric backgrounds. But this does not mean that **statistical argument** forms are deductive since they are characterized by probabilistic or sampling procedures to arrive at a conclusion.

Example:

The sum of two odd numbers is always even. Thus, the result of 3 and 9 is an even number.

- **An argument from definition** is a deductive argument form since the premises already define the truth of the conclusion.

Example: *God is omniscient, it follows that He knows everything.*

- **A categorical syllogism** is a deductive argument form. It is a syllogism (an argument form having exactly two premises) in which each of its statements usually begin with words: 'all', 'no' and 'some.'

Example:

All X are Y.
All Y are Z . $\Rightarrow$ This is a deductive argument form.
Therefore, all X are Z.

All animals are mammals.
All mammals are Living things. $\Rightarrow$ This is the substitution instance of the above deductive argument form.
Therefore, all animals are living things.

- **A Hypothetical syllogism** is a deductive argument, which is basically accompanied by an "If…then…" or conditional statement.

Example: *If X, then y.*

If y, then Z. ⇒ This is a deductive argument form, *therefore if X, then Z*

A Disjunctive Syllogism is a syllogism which is accompanied by statements beginning through an "Either…or …" phrase and it is a deductive argument form.

Example

Either x or y.
Not x . ⇒ This is a deductive argument form.
Therefore, y.

Its substitution instance is as follows:

Either Italy or Ethiopia won the military incident of Adwa. Italy did not win the military incident of Adwa. Therefore, Ethiopia won the military incident of Adwa.

Some Inductive argument forms

A Prediction is when somebody concludes about the future based on what was or is happening before as well as now. This is an inductive argument in the sense that it cannot show the future with certainty.

Example:

It has been raining for the whole day of this week, this shows that it will rain for the coming week.

An inductive generalization is when someone bases his/her conclusion on some particular instances, cases or samples.

Example:

There are 100 students who are taking the course; introduction to logic. Among these students 10 of them were selected at random and found to be intelligent. Therefore, this shows that all of these students are intelligent.

An argument from authority, which some one argues based on the witness of another person who lacks the experience, knowledge as well as ability, is an inductive argument.

Example:-

According to Dr. Kebede, who is a medical doctor at Black Lion hospital, Ethiopian economy is growing rapidly regardless of the global crises of 2008/9. Therefore, Ethiopian economy is growing fast as per the account of Dr. Kebede.

When knowledge about certain signs is attributed to certain situations to which these signs symbolize, it will be an inductive argument. And, arguments based on traffic signs; cautions of any marks and symbols usually contain inductive argumentations.

An argument based *on causation*, instances of cause and effect (cause to effect or effect to cause) which can never be known with absolute certainty, is an inductive argumentation.

Example –

- *Kenenisa is upset so that he is silent ⇒ cause to effect*

- *The meet is dry so that it had over cooked ⇒ effect to cause*

Evaluations of Arguments

As it has been underlined before, evaluating arguments based on fundamental principles and guidelines is among the central tasks of critical and rational scrutiny.

When we expose arguments to critical and rational scrutiny, we may witness that the premises, which are claimed to support the conclusion, fail to support the conclusion so that the information of premises becomes irrelevant or inconsistent to the conclusion. Thus, arguments having this nature can be evaluated as bad or illogical. On the contrary, if we witness an argument having sufficient, genuine and precise evidences or premises to the conclusion, then we can judge that the information of the premises are relevant, consistent and conducive to the conclusion. And an argument that satisfies this requirement can be evaluated as good or logical.

Therefore, as it has been underlined before, inferential claim is an indispensable criteria to evaluate arguments that if the premises of a given argument fail to logically support or imply the conclusion, the argument is bad and if the case is on the contrary it will result in good argument. And the primary task of this section is to evaluate arguments, particularly deductive and inductive arguments. And, as it has been explained before, the relationship between the premises and the conclusion of a deductive argument is a matter of necessity where as that of an inductive argument is a matter of probability. In any case, logicians employ different terminologies applicable so as to evaluate deductive and inductive arguments separately. And, this section gives us some detailed analysis and classifications of deductive and inductive arguments using those technical terms employed by logicians, which in fact can never violate the fundamental natures or characteristics of these two arguments.

Evaluating Deductive Arguments: Validity and Invalidity

As an introductory insight, there are four technical terms employed so as to evaluate deductive arguments; **valid, invalid, sound** and **unsound**. Initially a deductive argument can be divided into two forms: **Valid** and **invalid**. And, a **valid deductive argument** is an argument such that if the premises are assumed to be true, the conclusion must be true (it is impossible for the conclusion to be false). In other words, the logical connection between the premises and the conclusion of a **valid** deductive argument **is a matter of strict necessity**. If, on the other hand, the connection between the premises and the conclusion of an argument is not a matter of strict necessity in the sense that if the premises are assumed to be true, then there is a possibility for the conclusion to be false, such a deductive argument is **invalid.**

Moreover, there is no argument, which is partially or almost valid (there is not any third alternative other than valid and invalid arguments) that if the conclusion is followed with strict necessity from premises, the argument is valid; and if the case is on the opposite, the argument is invalid.

Validity and Truth

Another important point is that there is not any direct connection between validity and truth, in the sense that, it is not mandatory to have either true or false premises as well as conclusion so as to get a valid argument except an argument with true premises and false conclusion which is always invalid.

Truth and **falsity** are attributes of individual propositions or statements, which assert what really are the cases. When somebody asserts that Abay is the largest river in Ethiopia, he/she asserts what really is the case, means what is true. But if he/she asserts that the largest river in Ethiopia is Wabishable, his/her assertion would not be in accord with the actual world, therefore, it would be false. Thus, truth is the attribute of a proposition that asserts what really is the case, what is true; however, validity and invalidity are attributes of arguments. Just as the concept of validity does not apply to single propositions, the concept of truth does not apply to arguments.

In other words, the fact that statements of an argument are all true may not prove validity and the fact that all the statements of an argument are false do not prevent the argument from being valid.

In any case, the following possible combinations of true and false premises in both valid and invalid arguments:

I. Some Valid Arguments Contain all true Propositions-true premises and true conclusion:-

Example: - *All Mammals are animals.*
- *All cows are Mammals.*
- *Therefore, all cows are animals.*

II. Some Valid arguments have all false propositions-false premises and false conclusion:-

Example : *All Sharks are birds.*
All birds are politicians.
Therefore, all Sharks are Politicians.

Although the premises of the above argument are in fact false, the argument is valid. If they were true, the conclusion would have to be true as well. It is impossible for the conclusion to be false assuming that the premises are true. Thus, the above argument is valid.

III. Some invalid arguments have true premises and true Conclusion:-

Example:-

All birds are animals.
All grizzly bears are animals.
Therefore, all grizzly bears are birds.

The above argument is invalid because the truth of the conclusion does not follow the premises with strict necessity.

IV. Some invalid arguments contain all true premises have false conclusion:-

Example:

All banks are financial institutions.
Ethiopian Insurance is a financial institution.
Therefore, Ethiopian Insurance is a bank.

The premises of the above argument are true; however, the conclusion is false. Such an argument cannot be valid because it is impossible for the premises of a valid argument to be true and its conclusion to be false.

V. Some Valid arguments have false premises and true conclusion.

Example

All Asians are Africans.
<u>All Ethiopians</u> are Asians.
Therefore, all Ethiopians are Africans.

The conclusion of this argument is true; moreover, it may be validly inferred form the two premises, both of which are plainly false.

VI. Some invalid arguments also have false premises and true Conclusion:-

Example:

All Mammals have wings.
<u>All Whales</u> have wings.
Therefore, all whales are mammals.

VII. Some invalid arguments contain all false propositions-false premises and false conclusion:-

Example:

All Americans are Europeans.
<u>All Ethiopians</u> are Europeans.
Therefore, all Ethiopians are Americans.

In any case, as it has been underlined before, the above examples clearly witness that there is no direct link between validity and truth in the sense that the truth or falsity of the proposition or statement of an argument can never by itself guarantee the validity or invalidity of that argument. In short the following table will make the variety of possible combinations of validity and truth clear:

Premise	**Conclusion**	**Validity**
T- - - - - - - -	T- - - - - - - -- - - - - - -	?
T- - - - - - - -	F- - - - - - - -- - - - - - -	Invalid
F- - - - - - - -	T- - - - - - - - - - - - -- -	?
F- - - - - - - -	F- - - - - - - - - - - - - -	?

One can understand from the above table that the first, third, and fourth combinations show that the argument can be either valid or invalid depending primarily on whether the conclusion follows the premises with strict necessity or not (regardless of the truth and falsity of the premises and conclusion).

Another important exception in any deductive logic is indicated in the above table (in the second combination) which contains an argument of **true premises** and **false conclusion**. And any argument with such an arrangement is always **invalid**.

Validity and Soundness

A deductive argument can be considered as **sound if and only if** *it is valid* and *heaving all true premises*. If one of these two conditions is violated, the argument would rather be unsound.

Example:

All Mammals are animals.
<u>All humans</u> are mammals.
Therefore, all humans are animals.

The Conclusion of the above argument follows the premises with strict necessity so that the argument is valid. In addition to this, its premises are all true. Therefore, the above deductively valid argument is *sound*.

- **Sound argument = a valid argument + all true premises**

On the other hand, a deductively unsound argument falls into one of the following three categories:

- Valid but at least one false premise.
- Invalid but all its premises are true.
- Invalid and at least one false premise.

Example:
All Animals are mammals.
All birds are animals.
Therefore, all birds are mammals.

Though the above argument is valid (because if we assume that the premises are true, the conclusion would be necessary true), it is unsound because the argument involves plainly false premises.

Evaluating Inductive Arguments

Strength and Weakness

As it has been underlined before, an inductive argument is the one in which its premises are claimed to support the conclusion in such a way that if they are assumed to be true, then based on this assumption it is only probable that the conclusion is true. If the premises do in fact support the conclusion in this way, such an inductive argument can be considered as ***strong*.** Therefore, *a strong argument* is one such that it is unlikely, though possible, that its conclusion is false while its premises are true. Or it is highly probable that if its promises are true, then its conclusion is true in any inductively strong argument. If the premises are true, its conclusion has a higher probability of being true in any strong argument.

On the other hand, **a weak** inductive argument is one such that if the premises are assumed true, then based on this assumption, it is not probable that the conclusion is true. In other words, a weak inductive argument has this essential feature: It is not likely that if its premises are true, then its conclusion is true.

Example:

> *There has been rainfall throughout Ethiopia for the last few days. Therefore, probably it will be raining for the coming week.*

As it has been underlined before, validity does not admit of degree so that there is no any such argument to be said more valid/ less valid, or less invalid or more invalid. However, strength and weakness, unlike validity and invalidity, admit of degree so that we can have either stronger or weaker when we compare to other arguments. Moreover, like validity and invalidity, strength and weakness are only indirectly related to truth and falsity. The central question in determining strength and weakness of argument is not the truth and falsity of premises and conclusion but whether the conclusion would probably be true if the premises are assumed true. And, we can have the following combinations so as to reveal the indirect relationship between strength or weakness and truth or falsity:

I. A strong argument with true premises and a probably true conclusion

Example:

All previous American presidents were men. Therefore; probably the next American president will be man.

II. A weak inductive argument with true premises and a probably true conclusion.

Example:

A few American presidents were federalists. Therefore, probably the next American president will be a man.

III. A weak indicative argument with true premise and a probably false conclusion.

Example:

A few American presidents were federalists. Therefore, probably the next American president will be a federalist.

IV. A strong inductive argument with false premises and a probably true conclusion.

Example:

All Previous American presidents were television debates. Therefore, probably the next American president will be a television debater.

V. A weak inductive argument with false premise and probably true conclusion.

Example: *A few American presidents were libertarians. A few American presidents were libertarians. Therefore, probably the next American president will be a television debater.*

VI. A strong inductive argument with false premise and a probably false conclusion.

Example:- *All previous American presidents were women. Therefore, probably the next American president will be a woman.*

VII. A weak inductive argument with false promise and probably false conclusion.

Example:- *A few American presidents were Libertarians. Therefore, probably the next American president will be a Libertarian.*

And the following table will make the Varity of Possible combination of strength and truth clear:

Premises	Conclusion	Strength
T.	Prob. T. . . . .?	
T.	Prob. F.	Weak
F.	Prob. T.	?
F.	Prob. F.	?

Depending on whether the conclusion has a higher probability of following the premises (regardless of the truth and falsity of premises and the conclusion), the first, third and fourth combinations show that the argument can be either strong or weak. This shows that strength, like validity, is only indirectly related to truth and falsity.

However **any inductive argument with true premises and probably false conclusion is always weak,** which is an exception of any inductive logic.

Strength and Cogency

An inductively **cogent** argument has two essential features: (**a)** ***it is strong*** and (**b)** ***All its premises are true***. If one of these two conditions is missed, the argument would rather be **un-cogent**.

Thus, an inductively cogent argument = a strong argument + all true premises.

Example: - *Nearly all lemons that have been tasted were sour. Therefore, nearly all lemons are sour.*

This argument is not valid because the conclusion concerns are not merely the lemons that have been tasted but lemons in general, including those that have not been tasted. And, the premise does not rule out the possibility that a large percentage of untested lemons are not sour. Nevertheless, it is unlikely that the conclusion is false given that the promise is true. And, the premise is true so that the argument is **inductively cogent**.

Chapter Summary

Logic is the study of principles of correct reasoning so as to evaluate arguments. Arguments are groups of statements consisting of one or more premises and only one conclusion. Premises can be distinguished from conclusion either through the presence of indicator words (“thus”, “Since”, therefore” and etc.) or an inferential relation among statements. Moreover, it is mandatory to distinguish arguments form non-arguments since all forms of passages are not arguments. This can be accomplished by indicator words, the presence of an inferential relation among statements, and typical kinds of non-arguments.

Arguments can broadly be divided into two: Inductive and Deductive. Deductive arguments are those in which the conclusion is claimed to follow necessarily from the premises. On the other hand, inductive arguments are those in which the conclusion is claimed to follow only probably from the premises. To distinguish deductive arguments form inductive ones, using indicator words, using the actual strength of the inferential relation among statements, and typical deductive and inductive forms of argumentation.

As to the evaluation of deductive and inductive arguments, evaluating the link between the premises and conclusion is a mandatory logical procedure. Thus, deductive arguments, which their conclusion strictly follows from the premises, are called valid and their contraries are invalid. And a deductive argument, which is valid and having all true premises, are called sound. A deductive argument having true premises and a false conclusion is always invalid, which is the main exception in any deductive logic. Inductive arguments, which their conclusions actually follow from the premises, are called strong, and those that also have all true premises are considered as cogent.

The form of the argument the arguer uses can determine the validity of a deductive argument. Any argument form having a substitution instance with true premises and a false conclusion is an invalid form. And, Counterexample method is an important approach so as to prove the validity of a given argument.