Logical Reasoning

NTA UGC NET PAPER 1 STUDY MATERIAL

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LOGICAL REASONING

What is Argument?

An **argument** is a set of statements, one of which, the *conclusion* is taken to be supported by the remaining statements, the **premises**.

For **example;**

Premises: All men are mortal

Socrates is a man

Conclusion: Socrates is mortal

In the above example, there are three statements,

> 1) All men are mortal,
> 2) Socrates is a man, and
> 3) Socrates is mortal.

The premises of the Argument are the first two statement, and the last statement is a Conclusion. The statements of premises support the statement of conclusion. This type of arrangement is called an Argument.

Forms of Arguments

There are three types of Arguments:

> 1. **Deductive Arguments**
> 2. **Inductive arguments**, and
> 3. **Abductive arguments**

1. **Deductive Argument**:
   An argument where the conclusion <u>follows validly</u> from the premises. In other words, an argument where the truth of the premises <u>guarantees the</u> truth of the conclusion.

Example:
Premises: All men are mortal
                                    Socrates is a man
Conclusion   Socrates is mortal

In the above example, the premises, all men are mortal, and Socrates is a man, give a guarantee of the truth of the conclusion; Socrates is mortal. The conclusion follows the validity according to the premises.

2. Inductive Argument:

An argument where the premises point several cases of some pattern and the conclusion states that this pattern will hold in general.

An inductive argument will not be deductively valid, because even if a pattern is found many times, that does not guarantee it will always be found. Therefore, an inductive argument provides weaker, less trustworthy support for the conclusion than a deductive argument does.

For Example:

Premises: We have seen 1000 swans., and

All of them have been white.

Conclusion: All swans are white.

In the above example, we have seen just 1000 swans (not all in the world), and all of them have been white. But it does not mean that all swans in the world are white. White swans are a case of a pattern in those particular circumstances. Hence, we have concluded in general that all swans are white. But it might not be true actually. This type of arrangement of premises and conclusion is an example of an Inductive argument.

3. Abductive (or Hypothetico-Deductive) Argument:

An argument that (i) points out a particular fact, (ii) points out that if a particular hypothesis were true, we would get this fact, and so (iii) concludes that the hypothesis is indeed true.

Abductive arguments seem to make an even bigger jump than inductive arguments. Inductive arguments generalize, while abductive arguments say that successful predictions **"prove"** theory is true. Abductive arguments are not deductively valid because false theories can make true predictions. So, true predictions do not guarantee that the theory is true.

Example:

Premises: These coins conduct electricity (fact)

If these coins are made of gold (hypothesis), then they would conduct electricity (prediction).

Conclusion: These coins are made of gold

Structure of Categorical Propositions

A proposition is simply a claim about the world that has truth value. Every proposition can be expressed as a declarative (i.e., not a question or command) sentence.

Categorical Proposition is any statement which relates two classes or categories of entities. In other words, a categorical proposition is a proposition that relates two classes of objects. A **class** is a group of objects.

Example: Cats are mammals

Here, a class or category (Cats) are related to another class or category (Mammals). So, "Cats are mammals" is a Categorical proposition.

Components of Categorical Propositions

For any categorical proposition, there are four components:

- A. **Subject Term:** First category or class
- B. **Predicate Term:** Second category or class
- C. **Copula:** The grammatical link (verb) between subject and predicate terms.
- D. **Quantifiers:** Words that specify the quantity of the subject and predicate terms.

1. Universal:
   a. Affirmative: **'All'** (includes all of a class)
   b. Negative: **'No'** (excludes all of a class)
2. Particular: **'Some'** (includes part of a class)
      Example: All cats are mammals
      Here, All – Quantifier
      Cats – Subject Term
      Are – Copula
      Mammals – Predicate term

Properties of Categorical Propositions
Each categorical proposition has both quantity and quality properties. The followings are the properties:

Quantity: The quantity of a categorical proposition is determined by the quantifier used.

Quality: The quality of a categorical proposition is determined according to whether the proposition asserts of denies an overlap between the classes.

Affirmative: if a proposition asserts an overlap between the classes or category named, the quality of the proposition is affirmative.

Negative: In this, a proposition denies an overlap between the categories or classes named,

Distribution: If the proposition refers to the entire class named by a term, that term is distributed and if it does not refer to the entire class named by a term, then the term is undistributed.

Types of Categorical Proposition

There are four types of categorical position:

1. All politicians are liars (**Universal Affirmative) - A**
2. No politicians are liars. (**Universal Negative) - E**
3. Some politicians are liars. (**Particular affirmative) - I**
4. Some politicians are not liars. (**Particular negative) - O**

1. **Universal Affirmative (**A- Propositions): In a proposition, if every member of the subject class is also a member of the predicate class, then it is called **Universal Affirmative Proposition**. In other words, whole of one class is included or contained in another class.

   In an example **"All politicians are liars"**, every member of the class of politicians, is a member of another class of liars.

   A universal affirmative proposition can be written as: **All S is P**

   S and P represent the subject and predicate terms, respectively. Such a proposition affirms that the relation of class inclusion holds between the two classes and says that the inclusion is complete, or universal.

2. **Universal Negative (E- Proposition):** The proposition in which no members of the subject class are members of the predicate class.

   In an example **"No politicians are liars",** no member of the class of politicians, is a member of another class of liars.

   Systematically, Universal Negative proposition can be represented as: **No S is P**

   Such a proposition affirms that the no relation of class inclusion holds between the two classes and says that the exclusion is complete, or universal.

3. **Particular affirmative (I-proposition):** The proposition in which at least one member of the subject class is also a member of the predicate class.

   In an example "Some politicians are liars", some member of the class of politicians, is a member of another class of liars.

   Systematically, **Particular affirmative** proposition can be represented as: **Some S is P**

4. **Particular negative (O-**proposition): The proposition in which **at least one** members of the subject class is **not** a member of the predicate class.

   In an example **"Some politicians are not liars",** some member of the class of politicians, is a member of another class of liars.

   Systematically, Particular affirmative proposition can be represented as:
   Some S is not P. A brief of Four Kind of Categorical Proposition

Type	Quantifier	Subject	Copula	Predicate
A	All	S	are	P
E	All (No)	S	are not (are)	P
I	Some	S	are	P
O	Some	S	are not	P

Complete Chart for categorical Proposition (Helpful for Exam)

Type	Quantifier	Subject	Copula	Predicate	Quantity	Quality	Subject Term	Predicate Term
A	All	S	are	P	Universal	Affirmative	Distributed	Undistributed
E	All (No)	S	are not (are)	P	Universal	Negative	Distributed	Distributed

I	Some	S	are	P	Particular	Affirmative	Undistributed	Undistributed
O	Some	S	are not	P	Particular	Negative	Undistributed	Distributed

It is important to remember this chart because the properties of categorical propositions are used as one method of determining the validity of a categorical syllogism.

Classical Square of Opposition

The opposition is an immediate inference grounded on the relation between propositions which have the same terms but differ in quantity or quality (or both).

For any formal opposition between two propositions, it is essential that their terms should be the same. There can be no opposition between two such propositions as these:

(1)   All angels have wings.
(2)   No cows are carnivorous.

The **square of opposition** shows us the logical inferences (**immediate** inferences) we can make from one proposition type (**A**, **I**, **E**, and **O**) to another.
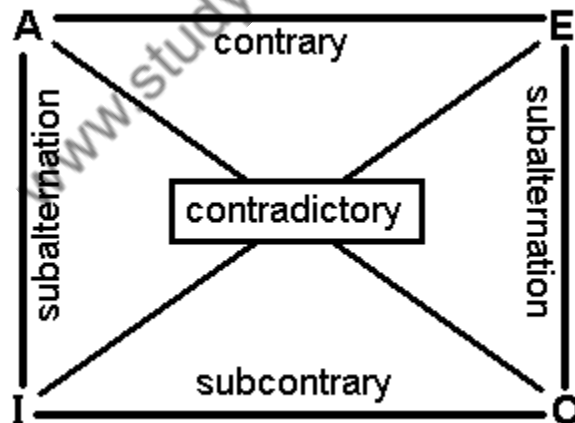
Contradictories: Two propositions are said to be **contradictories** if both cannot be true, and both cannot be false at the same time. In other words, if the opposition is between two propositions, which differ both in quantity and quality.

Here, **A** – All politicians are liars and **O** - Some politicians are not liars, and similarly, **E** and **I** propositions are contradictories.
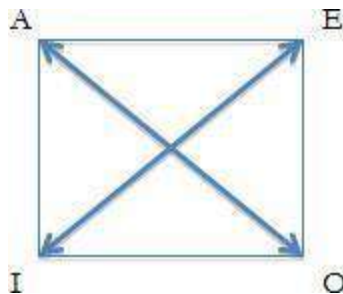
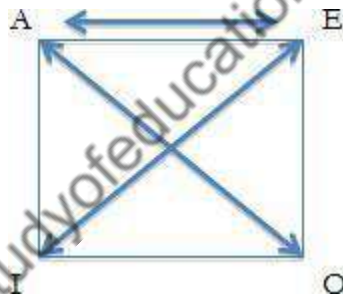**Contraries:** Universal propositions are said to be **contraries** because they cannot both be simultaneously true. In other words, the opposition is between two universals which differ in quality.

A- All politicians are liars is true, the **E-** No politicians are liars must be false. Simalrly, if the **E-**

proposition is true, then the **A-**proposition is false.

Sub contraries: If the two particular propositions can both be true but cannot both be false. In other words, the opposition is between two particulars which differ in quality. It means that they cannot both be simultaneously false.
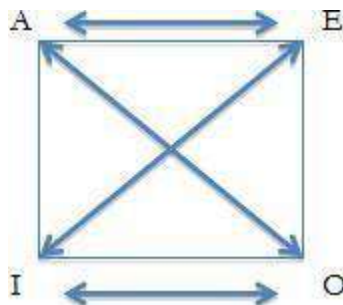
Sub alternation: The universal to particular and particular to universal inferences are called sub alternation. In other words, the opposition is between two propositions which differ only in quantity.

These inferences are valid if the superaltern (**A** or **E**) is true, then the subaltern (**I** or **O**) is true. If the subaltern is false, then the superaltern is false.
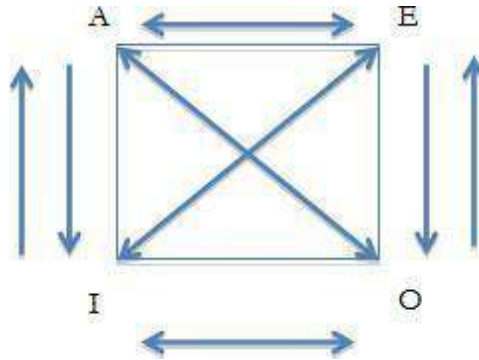
Categorical Syllogism

A syllogism is an argument containing two premises and a conclusion.

Categorical syllogisms: A categorical syllogism is a syllogism whose premises and conclusion are categorical propositions.

For **example:**

Premises:

1. All hats are fashionable clothing.
2. All fashionable clothing is purple.

Conclusion:

3. So, some hats are purple.

A Standard Form Categorical Syllogism Contains:

- Two premises and a conclusion, each a standard form categorical proposition.
- **Major Term:** A major term which appears only in the first premise and the predicate of the conclusion.
- **Minor Term:** A minor term which appears only in the second premise and the subject of the conclusion
- **Middle Term:** A middle term which appears in both premises but not in the

conclusion.

- **Major Premises:** The major premise is the premise which contains the major term.
- **Minor Premise:** The minor premise is the premise which contains the minor term.

Mood and Figure of Syllogism

The categorical syllogisms can be categorize as:

- The kind of standard form categorical proposition which appears as its first (i.e., major) premise,
- The kind of standard form categorical proposition which appears as its second (i.e., minor) premise, and
- The kind of standard form categorical propositions which appears as its conclusion.

Mood: When the major premise, the minor premise, and the conclusion of a categorical syllogism arrange in a series of three letters (A, E, I, or O) corresponding to the type of categorical proposition is called MOOD of an argument.

Example:
    Premises: All P are M

         All S are M

   Conclusion: Some S are P

    The first premise is of the form A
    The second premise is of the form A
    The conclusion is of the form I
    The conclusion is of the form I I

In another example, to figure out the FORM of the premises and the conclusion in the following example:
Premises:
    1. No S are P (E-propostion)
    2. Some S are P (I-Proposition)
Conclusion:
    3. Some S are not P (O-Proposition)

Thus, the mood of this Argument is **"EIO".**

When you have to determine the mood of a categorical syllogism, you need to find out which of the four forms of categorical proposition each line of the Argument is (A, E, I, or O).

Figure

The figure of a categorical syllogism is **a number** which corresponds to the placement of the two middle terms.

For example, consider the following arguments:

P 1. All mammals are creatures that have hair

P 2. All dogs are mammals.

P 3. Therefore, all dogs are creatures that have hair.

Notice that the middle term in the major premise is on the LEFT, while the middle term in the minor premise is on the RIGHT. Whenever this happens, we say that the argument has figure "1."

There are four possible figures in the categorical syllogism:

Figure1: When the middle term is on the left in P 1, and on the right in P 2.

Figure2: When the middle term is on the right in both premises.

Figure3: When the middle term is on the left in both premises.

Figure4: When the middle term is on the right in P 1, and on the left in P 2.

Important Points of Mood and Figures:

- There are 64 different moods
- And each mood has 4 different figures.
- Thus, there are 64*4=**256 different kinds** of standard form categorical syllogisms.

Valid Argument Forms

There are two kinds of valid argument forms:

1. **Unconditionally Valid Forms:** There are **fifteen combinations** of mood and figures that are valid from the Boolean standpoint, and we call these "unconditionally valid" argument forms. The chart below depicts ALL of 15 the unconditionally

valid argument forms.

UNCONDITIONALLY VALID FORMS

Figure 1	Figure 2	Figure 3	Figure 4
AAA	EAE	IAI	AEE
EAE	AEE	AII	IAI
AII	EIO	OAO	EIO
EIO	AOO	EIO	

2.   **Conditionally Valid Forms:** There are some inferences that are NOT valid from the Boolean standpoint, which is valid from the Aristotelian standpoint. In addition to the fifteen unconditionally valid argument forms, there are nine conditionally valid argument forms for categorical syllogisms:

CONDITIONALLY VALID FORMS

Figure 1	Figure 2	Figure 3	Figure 4	Required condition
AAI	AEO		AEO	S exists
EAO	EAO			
		AAI	EAO	M exists
		EAO		
			AAI	P exists

RULES FOR VALIDITY

A standard form categorical syllogism is valid on the modern theory if and only if each of the following five propositions is all true of it. A standard form categorical syllogism is valid on the traditional theory if and only if each of the first four propositions is true of it.

1. The middle-term is distributed at least once.

2. If a term is distributed in a conclusion, then that term is distributed in one of the premises.

3. There is at least one affirmative premise.

4. There is a negative premise if and only if there is a negative conclusion.

5. If both premises are universal, then the conclusion is universal.

Informal and Formal Fallacy:

Simply, a fallacy is a mistake in reasoning. In other words, a defect in an argument that misleads the mind is called a fallacy.

There are two types of fallacy:

Formal Fallacies: A fallacy in which there is the involvement of an error in the form, arrangement, or technical structure of an argument is called Formal Fallacy.

Informal Fallacies: Informal fallacies are a matter of unclear expression that deal with the logic of the meaning of language. Opposite to it, formal fallacies deal with the logic of the technical structure.

An informal fallacy involves such things as:

● the misuse of language such as words or grammar,
● misstatements of fact or opinion,
● misconceptions due to underlying presuppositions, or
● just plain illogical sequences of thought.

Uses of Language in Logic

A logic always deals with the analysis and evaluation of arguments. Since arguments are expressed in language, the study of arguments requires a carefully attention to language in which arguments are expressed.

The followings are three important uses of language:

1. **Informative,**

2. **Expressive and**

3. **Directive uses of language.**

1. Informative use of language: It involves an effort to communicate some content or to describe something or to give information about something. When I say a child, "The Second of October is the Gandhi Jayanti." **The language I used is informative.**

This kind of use of language presumes that the content of what is being communicated is true, so it will be our main focus in the study of logic.

When a sentence is used informatively, it reports that something has some feature or that something lacks some feature. Consider the following two sentences:

1. Parrot has a feather.

2. Parrot is not mammals.

The first proposition reports that having feather is a feature of a Parrot. The second proposition reports that Parrot do not have some essential qualities found in mammals. In, both cases it provides information about the world.

Two main aspects of this function are generally noted: (1) evoking certain feelings and (2) expressing feelings.

Expressive discourse, qua expressive discourse, is best regarded as neither true or false.

2. Expressive use of Language: This type of l**anguage is often used to express our emotions, feelings, or attitudes. For example:** It's too bad! It's wonderful! etc.

When language is used expressively or emotively, it cannot be characterized as true or false.

3. Directive uses of language: When the use of llanguage is often to give direction as Commands, requests, instructions, questions etc., to do or not to do something.

Consider the following examples:

1. Finish your homework.

2. Wash your clothes.

3. Are you feeling well?

In all the above examples, **the directive** uses language. Directive use of language is not normally considered true or false (although various logics of commands have been developed).

Connotations and Denotations of Terms

Denotation is the dictionary definition or literal meaning of a word only. Not emotions or feelings are associated with the word.

Ex: The teacher walked into the classroom. This example does not have any hidden meaning. A teacher simply walked into a classroom.

Connotation: A word's emotional meaning; suggestions and associations that are connected to a word. Words can be positive, negative, or neutral. Words can also connote specific feelings or emotions.

Different types of Definition

Lexical: The purpose of a lexical definition is to report the way a word is standardly used in a language. Most definitions found in a dictionary are lexical definitions.

Ex. Fossil, Cat, Dogs etc.

Persuasive: The purpose of a persuasive definition is to influence people's attitudes, not to neutrally and objectively capture the standard meaning of a word.

Eg. Teenagers, Abortion etc.

Stipulative: A stipulative definition stipulates (assigns) a meaning to a word by coining a new word or giving an old word a new meaning. A stipulative definition is neither true nor false; it is neither accurate nor inaccurate.

Eg. Sugarnecker, Black Holes, etc.

Theoretical: Theoretical definitions can explain concepts theoretically. Sometimes definitions are given for terms, not because the word itself is unfamiliar, but because the term is not understood. Such concepts require theoretical definitions, which are often scientific or philosophical in nature.

For example, when your chemistry teacher defines water by its chemical formula H_2O, he is not trying to increase your vocabulary (you already knew the term water), but to explain its atomic structure.

Accepting a theoretical definition is like accepting a theory about the term being defined. If you define spirit as "the life-giving principle of physical organisms," you are   inviting others to   accept the idea that life is somehow a spiritual product.

Precising: A precising definition takes a word that is normally vague and gives it a clear precisely defined meaning.

Eg. Lite, Low-income, middle aged, etc.

Evaluating and distinguishing deductive and inductive reasoning

Reasoning: According to the Oxford Dictionary, Reasoning can be defined as "the action of thinking about something in a logical, sensible way."

Merriam-Webster dictionary defines as "the process of thinking about something in a logical way in order to form a conclusion or judgment. Or, the ability of the mind to think and understand things in a logical way."

We can say that reasoning is a process of using existing knowledge to draw conclusions, make predictions, or construct explanations in a logical way.

There are two major types of reasoning, **deductive and inductive. The third type of** reasoning is Abductive reasoning. We will discuss only the first two.

Deductive and Inductive Reasoning

Deductive reasoning: Deductive reasoning is an argument in which widely accepted truths are being used to prove that a conclusion is right. The truths can be the recognised rules, laws, theories, and others. In other words, deductive reasoning starts with the assertion of general rule and proceeds from there to a guaranteed specific conclusion.

In practice, syllogism is the most basic form of deductive reasoning, where two premises that share some idea support a conclusion. It may be easier to think of syllogisms as the following theorem: If A=B and C=A, then B=C.

Deductive reasoning is meant to demonstrate that the conclusion is absolutely true based on the logic of the premises. We will understand the deductive reasoning by comparing the following example of syllogisms:

Example A:

> All musical instruments make sounds.
> Airplanes make sounds.

Therefore, airplanes are musical instruments.

The example A contains two objectively true premises, but its conclusion is false. Because airplanes and musical instruments are totally separate entities while still having the same properties.

Example B:

All art is an imitation of nature.

Music is art.

Therefore, music is an imitation of nature.

In example B, the premises are overlapping, and this premises support and prove that a conclusive statement is definitely true.

You can more easily imagine the above arguments like this:

Inductive Reasoning
"Inductive reasoning is a method of argument in which the premises are viewed as supplying some evidence for the truth of the conclusion."

Most of the dictionaries define inductive reasoning "as the derivation of general principles from specific observations."

Inductive reasoning begins with observations which are specific and limited in scope and then proceeds to a generalized conclusion that is likely, but not sure, in light of accumulated evidence. You could say that inductive reasoning moves from the specific to the general.

Compare these inductive arguments:

Example A: The cost of education has been increasing over the past several decades.

Therefore, higher taxes on the rich Indian are probably the best way to help middle class Indians.

Example B: The past two Dabangg movies have been incredibly successful at the box office. Therefore, the next Dabangg movie will probably be successful.

The reasoning in example A is weak while example B is strong. In example A, the two statements made are likely true on their own, but the first premise does not predict the second to be true. Since there is no obvious correlation between the two, the argument is weak.

In the example B, the premise identifies a pattern, and the conclusion provides a logical continuation of this pattern without exaggeration. Thus, the argument is strong

The followings are the differences between deductive and inductive reasoning

Basis for comparison	Deductive Reasoning	Inductive Reasoning
Approach	It follows a top down approach.	It follows a bottom-up approach.
Starts from	Deductive reasoning starts from Premises.	Inductive reasoning starts from the Conclusion.
Validity	The conclusion must be true if the premises are true.	the truth of conclusions does not guarantee by the truth of premises.
Usage	It is difficult to use, as we need facts which must be true.	It is fast and easy, as we need evidence instead of true facts. We often use it in our daily life.
Process	Theory – hypothesis – patterns - confirmation.	Observations – patterns – hypothesis - Theory.
Argument	Arguments may be valid or invalid.	Arguments may be weak or strong.
Structure	It reaches from general facts to specific facts.	It reaches from specific facts to general facts.

| Qualitative /Quantitaive	It is more precise and quantitative.	It is more general and qualitative.

Analogies

Analogy basically means similarity of one object to another in certain aspects. The purpose of analogy is to test the ability to identify the relationship between the pairs of numbers, letters or words.

A given question consists of words, letters or numbers related to each other based on some logic and it is required to identify a word, letter or number analogous to those given in the question.
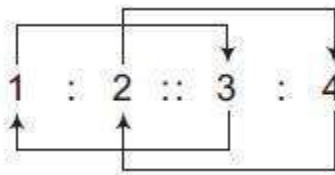
The analogical relationship can be established in two ways as follows:

A. **Basic Relation:** The basic relation can be followed as:
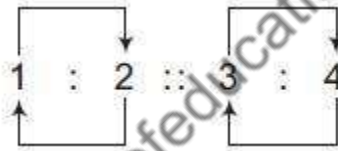
In above illustration, the relation of No. 3 to No. 4 or No. 4 to No.3 is in the same pattern as the relation of No.1 to No. 2 or No. 2 to No. 1

B. **Advanced Relation:** Th advanced relation is as follows;

Here in the illustration, the relation of '2' to '4' or '4' to '2' is the same as the relation of '1' to '3' or '3' to '1'.

For more clarity about the analogical relationship,

let us consider the example given below:

Doctor : Hospital : : Teacher : School

After a deeper relationship analysis, we will find the following

A. Doctor : Hospital

A doctor works in a hospital. It means a hospital is a working place for a doctor. Hence, the Doctor and Hospital have a worker and working place relationship.

B. Teacher : School

A teacher works in a school. It means school is the working place for a teacher. Hence, Teacher and School have a worker and working place relationship.

It is observed that in both cases A and B, the relationship is in a similar pattern, that is, the relationship as a worker and working place. Therefore, we can say that the above examples are analogical pairs.

There are several categories of questions under Analogy; Some of them are as follows:

- Analogous Pair Completion
- Analogous Pair Selection
- Direct or Simple Analogy
- Double Analogy
- Similar Word Selection
- Analogy Detection
- Multiple Word Analogy
- Letter Based Analogy (Unit 5- Reasoning)
- Number Based Analogy (Unit 5- Reasoning)

We don't need to go to a deep study of analogies. The simplest form of questions is asked in the UGC NET Exam.

We are here to explain the simplest form of analogical questions only.

Analogous Pair Completion

In this type of question, 2 pairs of words are given, and the words in the first pair are related to each other in a specific way.

For Example:

Leaf : Tree : : Page : ?

(a) Forest (b) Root (c) Red (d) Book

Ans. (d) 'Leaf' is the part of 'Tree' and similarly 'Page' is the part of 'Book.'

Analogous Pair Selection

In this case of analogy, a pair of words is given, which is followed by four pairs of words as options to choose the correct pair.

Example; Introvert: Extrovert

(a) Against : Favour
(b) Extreme : Interim
(c) Angle : Tangent
(d) Action : Law

Ans. (a) Introvert is an antonym of Extrovert. Similarly, Against is an antonym of Favour.

Direct or Simple Analogy

In this case, two words are given, which are related to each other in a particular manner. Another word is given followed by four options. First to identify the relationship between the first two words. Then, to pick that word from the options, which bears the exact same relationship to the third word, as the first two bear.

Example

"Melt" is related to Liquid in the same way as "freeze" is related to

Options: (a) Ice (b) Crystal (c) Water (d) Cubes

Ans. (a) "Melt" is associated with "Liquid" because after melting, we obtain liquid. Similarly, the state of "Water" after freezing is 'Ice.'

Double Analogy

In this case, 2 words are given on both the left and right side of the sign of double colon (::). On both sides, one of the two words is left out marked as A and B or I and II. The question is followed by four options from which a candidate is required to find out the correct pair of words. The selected pair will make an appropriate analogical relationship between the two words to the left and similarly two words to the right of the sign of double colon (::).

Example

A : Wheat : : Brick : B

Options: (a) A. Bread , B. Clay   (b) A. Cereal, B. Clay

    (c) A. Farmer, B. Mason   (d) A. Farmer, B. Clay

Ans. (a) 'Wheat' is used to make 'Bread'. Similarly, 'Clay' isused to make 'Brick'.

Similar Word Selection

In this types of analogy, a group of 3 or 4 words is given followed by 4 other words as alternatives. Then, have to choose the alternative, which is similar to the given words.

Example

Mumbai: Lucknow : Kolkata

Options: (a) Pune (b) Bikaner (c) Patna (d) Ludhiana

Ans. (c) Mumbai, Lucknow, and Kolkata are the capitals of 3 Indian states. Similarly, Patna is the capital of Bihar.

Analogy Detection

In this analogy, the candidate is required to identify the common feature among the given words and pick the right alternative that mentions the properties common to the given words.

Example

Nose : Eyes : Ears

Options:

(a) They are parts of the body below waist
(b)   They are not the external part of human body
(c)   They are internal part of human body
(d)   They are parts of the body above neck

Ans.(d) 'Nose,' 'Eyes,' and 'Ears' are the parts of the human body above the neck.

Multiple Word Analogy

In this case, a group of 3 or 4 inter-related words is given. To solve the analogy, the right group of words is required to choose from the options provided. The relationship among these words should have similar relationships as words inter-related in question.

Example

Furniture : Table : Almirah

Options:

(a) Building : Wall : Brick
(b)   Fruit : Orange : Apple
(c)   Mother : Father : Sister
(d)   Sea : Road : City

Ans.(b) 'Orange' and 'Apple' are both 'Fruits' as similar relation of 'Table' and 'Almirah' with 'Furniture'.

Venn diagram: Simple and multiple uses for establishing the validity of arguments

Venn Diagram

Venn diagram is an illustration of the relationships between and among sets, groups of objects that share something in common.

A Venn diagram uses overlapping circles or other shapes to illustrate the logical relationships between two or more sets of items. They serve to graphically organize things and highlighting how the items are similar and different.

The main aim of the Venn Diagram is to test the validity of arguments through the relation between premises and conclusion by diagrams.

For example:
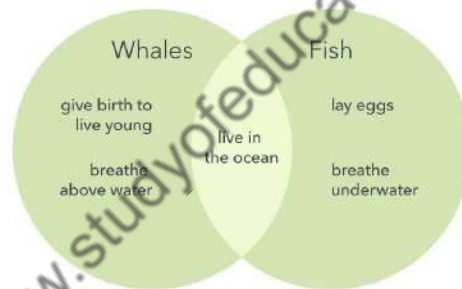
Source: lucid chart

In this example, Whales and Fish belong to two different groups, but there is something common between them. The common feature is, they live in the ocean, and it has easily represented by two circles overlapping to some extent.

There are TEN conditions by which we can test the validity of arguments. The conditions are followings:

Condition 1: If all the items are of different groups, then they will be shown by the diagram as given below.
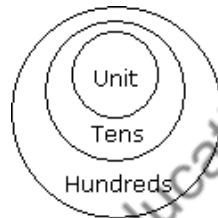For e.g. Dog, Cow, Horse
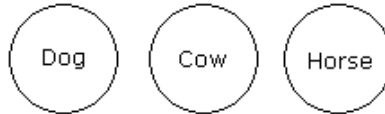
These animals are of three different groups; there is no relation between them. Hence, they will be represented by three different circles.

Condition 2: If the first word is related to the second word, and the second word is related to the third word. Then the representation will be shown by diagram as given below.

E.g., Unit, Tens, Hundreds

Ten units together make one Ten (in one ten, the whole unit is available), and ten tens together make one hundred.

Condition 3: If two different items are entirely related to the third item, they will be shown as below. E.g., Pen, Pencil, Stationery
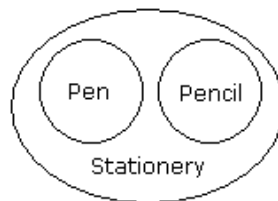
Condition 4: If there is some relation between two items, and these two items are completely related to a third item, they will be shown as given below.

E.g., Women, Sisters, Mothers
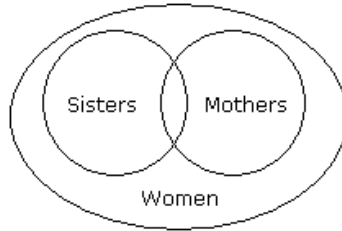
Some sisters may be mothers and vice-versa. Similarly, some mothers may not be sisters and vice-versa. But all the sisters and mothers belong to women group.

Condition 5: Two items are related to a third item to some extent but not completely, and the first two items totally different.

E.g., Students, Boys, Girls

The boys and girls are different items, while some boys may be students. Similarly, among girls, some may be students.

Condition 6: All the three items are related to one another, but some extent, not completely.

E.g., Boys, Students, Athletes
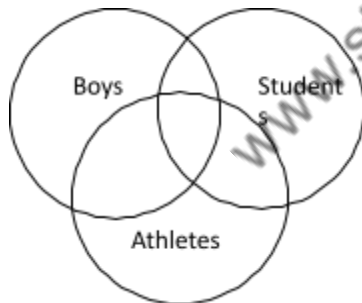
Some boys may be students and vice-versa. Similarly, some boys may be athletes and vice-versa. Some students may be athletes and vice-versa.

Condition 7: Two items are related to each other completely, and the third item is entirely different from the first two.

E.g., Lions, Carnivorous, Cows

All lions are carnivorous, but no cow is lion or carnivorous.

Condition 8: The first item is completely related to the second, and the third item is partially related to the first and second items. Eg. Females, Mothers, Doctors

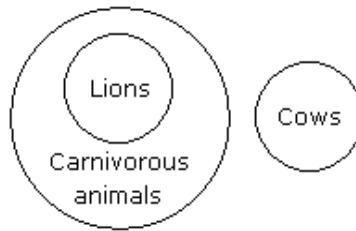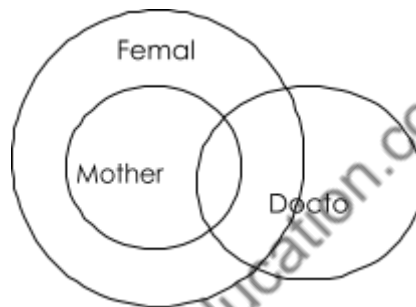In the example, all Mothers belong to Females, but some Mothers are Doctors, but not all.

Condition 9: First item is partially related to the second, but the third is entirely different from the first two. E.g., Dogs, Flesh-eaters, Cows
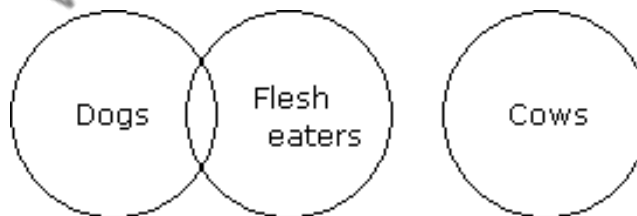
Some dogs are flesh-eaters, but not all while any dog or any flesh-eater cannot be a cow.
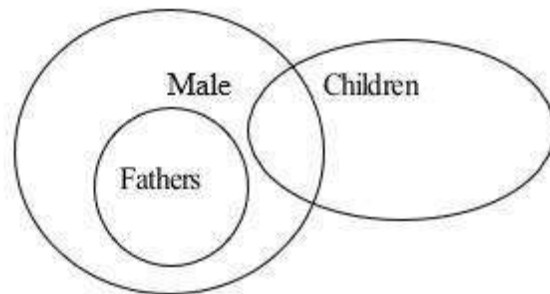
Condition 10: The first item is wholly related to the second, and the third item is partially related to the first and second items.

E.g., Males, Fathers, Children

Indian Logic: Means of knowledge

Logic is the study of inference and argument. Logic has always fascinated humankind for its sheer scope of immense arguments and discussions. It is the scientific study of 'reasoning. Using the term "Scientific" does not mean anything related to the basic sciences. The usage of the term is primarily more as an adjective meant to qualify how the study is undertaken. Indian logic has been differently viewed in the different ages. Many academicians have discussed Indian logic as a system by dissociating 'Buddhist logic' from it. Indian logic must be studied as the form of correct arguments and inference patterns, which was developed in India from the methodology of philosophical debate.

Schools of Indian Logic:

The development of Indian logic over the ages can be classified into the following categories:

- Ancient
- Medieval
- Modern

Indian Ancient School (650 B.C. to 100 A.D)

Indian ancient school had a great impact on the development of Indian logic. Ancient school offers a fine treatment of soul distinguishing carefully between knowledge and work. The Upanishads are dealt with the soul and its destiny constituted a very important branch of study called *Aatmaa-vidyaa (the science of soul)*, and *Adhyatma-vidyaa (the Divine Science).*

Aatmaa Vidya was at a later stage called **Ānvīkṣikī (the science of inquiry).** About 650 B.C. Ānvīkṣikī bifurcates into philosophy and Logic, named as *Darsana* and *Hetu-Vidya* or *Tark-Vidyaa,* respectively.

However, *tark-vidya* was not received with favor by the particular section of the *Brahmanas*. In *the Ramayana, Valmiki* discredits those who are indulged in the seriousness of the science of Logic. *Vyasa* in *Mahabharata,* says that who has the addiction to logic, will be turned into a jackal in his next birth.

Several stories of inflicting of penalties on those given to the study of *Tark- Vidyā* are found in plenty in the *Skandapurāna* and other works.

Despite of it, *Ānvīsikī* was held in very high esteem due to the authority that it attaches to the *vedas*. Kings were trained in logic, and the entity of reasoning was acknowledged in the administration of justice.

Kautilya, in his *arthaśāstra* characterises **Ānvīshikī** (logic) as the lamp of all sciences. It seems that the unfavorable criticism to which *Ānvīsikī* had long been exposed, terminated practically in the first century

A.D. under the name of **Nyāya- Sāstra**.

Between 1 A.D. and 100 A.D., there was the growth of the name **Nyāya** ('right' or 'justice'). **Nyaya- Sastra** is, therefore, the science of right judgment or valid reasoning. It is the science of inference for the sake of others. It is also the science of demonstration.

The first regular work on the *Nyāya Sāstra* is the **Nyāya Sūtra** or "aphorism on true reasoning." The book is divided into five other books, each book containing two chapters called *āhnikas* (diurnal portion). It contains the references to the **Sānkhya, Vaiśesika, Yoga, Mimāṃsā, Vedānta** and Buddhist System of philosophy. The **Nyāya sūtra** consists of **sixteen categories**, which comprise all the topics of the course debate.

The categories are:

1. The right means of knowledge (*pramāna*)
2. The object of right knowledge (*prameya*)
3. Doubt (*samśya*)
4. Purpose (*prayojana*)
5. Example (*drastānta*)
6. Tenet (*sidhānta*)
7. Members (*avayava*)
8. Confutation (*tarka*)
9. Ascertainment (*nirnaya*)
10. Discussion (*vāda*)

11. Wrangling (*jalpa*)
12. Cavil (*vitaṇḍā*)
13. Fallacy(*hetrābhāsa*)
14. Quibble (*chhala*)
15. Analogue (*jāti*)
16. The point of defeat (*nigrahasthāna*)

Perception, inference, comparison, and a word or verbal testimony are the means of right knowledge. Soul, body, senses, intellect, mind, activity, fault, transmigration, fruit, pain, and emancipation are the objects of the right knowledge.

Medieval School of Indian Logic (100 A.D. to 1200 A.D.):

The unique features of medieval logic are the termination of the ancient school, the formation of school under the influence of Jain and Buddhist ideas of logic. The ancient logic dealt with sixteen categories comprising heterogeneous elements as a doctrine of salvation and the nature of soul etc. Inference, a kind of *pramāna*, which was briefly noticed in the ancient logic, receives full treatment in the medieval school. The number of technical terms were coined, and great subtleties were introduced in the definitions. The medieval logic thus formed, is called **pramāna sāstra** in Sanskrit, which means the science of the right knowledge.

According to the **Jains,** logic was called '**hetu**'. *Hetu* as similar with valid knowledge is stated to be of four kinds:

1) Knowledge derived from perception (pratyaksa)
2) Knowledge derived from inference (anumana)
3) Knowledge derived from comparison (upamana)
4) Knowledge derived from verbal testimony (sabda)

The main categories, in the course of study of logic according to the Jain school are:

- **Valid knowledge (*pramāna*):** This is the knowledge which ascertains the nature of what was uncertain to one's self.
- **Syllogism (*Vyāpti*):** This is the inseparable connection between two terms.
- Reason (*hetu*): Reason is divided as (a) perceptible and (b) imperceptible.
- Example (*dṛṣṭānta*): For the sake of explaining matters to men of small intellect,the example becomes a part of inference.
- Inference (*anumāna*):
- Verbal testimony (*āgama*): This the knowledge of object derived from the words of reliable persons or scriptures in virtue of their natural fitness or suggestiveness.

- Scope of valid knowledge (*viṣaya*)
- Fallacy (*ābhāsa*)

The following categories are considered by the Buddhist school of logic:

Valid knowledge: only two *pramānas*, perception and inference in opposition to the four *pramānas* of the *Nyāya-Sutra*,

Reason (*hetu*): Similar concept of '*hetu*' according to the ancient school.

Example (*dṛṣṭānta*): It is to pointing out the connection of the reason with the major terms, one should state examples.

Negation (*apoha*): An entity is defined as being the negation of its opposites.

Analogues (*Jāti*): The concept of analogues is almost similar to the concept of "*Jāti*" in the *Nyāya- Sutra*.

Since the Brāhmaṇas did not differ in respect to their social practices from the Jains, Brāhmaṇas attack on Jain Logic was not as violent as that on the Buddhist Logic. In fact, the logical theories of the Jains

are in many cases similar to those of the *Brāhmanas*. The different categories of logic as described in the *Nyāya Sutra* are very much similar to the Jain school but differ significantly from the Buddhist school.

Modern School of Indian Logic

In the Deccan regions of India, the decline of Buddhism commence in the seventh century A.D. The Brāhmaṇas, borrowed the Budhist logic from the work of the mediaeval school, but for other matters they went back to the works of the ancient school.

The works so composed in the modern period were technically called "Prakaraṇas" or Manuals of logic. The manuals are remarkable for their accuracy and lucidity.

The main categories of the cause of logic as identified in the manuals are:

1. **Pramāṇa (valid knowledge):** which can be classified into:
   - Perception (pratyaksha)
   - Inference (anumāna)
   - Verbal Testimony (āgama)

2. **Hetvābhasa (fallacy of reason):** Which can be classified as-

- Unproved (asiddha)
- The contradictory (viruddha)
- The uncertain (anaikāntika)
- Non-tried or non-conclusion
- Mistimed or incompatible reason
- Non- erroneous contradiction

3. **Example (udāharaṇa)**
4. **Verbal Testimony(āgama)**
5. **Emancipation (Mokṣha)**

The modern school of Logic suggests that the soul is of two kinds, viz. the individual soul (aparaātma) and the supreme soul (para ātma). With the knowledge of the supreme soul, the individual soul attains final emancipation.

The *"tarka"* is an important component of Logic. But it does not provide any originality in information. It only proves what has already been known by regular syllogism. The sānkhya, Yoga and Vedānta believe in *buddhi* but the *Nyāya* and the *Vaiśesika* do not consider *Budhhi* as reason. It is only an adventitious consciousness that arises like a spark or light when mind (*manas)* comes into contact with the *aatman.*

Pramanas

Pramana ("sources of knowledge" or "measure") is an epistemological term in Indian and Buddhist philosophies referring to the means by which a person obtains accurate and valid knowledge (Prama, pramiti) of the world. In obtaining Prama, or correct knowledge, Pramana forms one part of a triputi (trio):

- Pramata, the subject, the knower
- Pramaṇa, the means of obtaining the knowledge
- Prameya, the object, the knowable

The three-principal means of knowledge are:

- Pratyaksa (Perception)
- Anumana (Inference), and
- Sabda (Word)

The Sabda (word) is derived from the Veda, which is considered to be inherently valid. Some philosophers include the statements of reliable persons (apta-vakya) in the concept of Word (sabda), and add two additional means of obtaining knowledge:

- Upamana (Analogy): enables one to hold on the meaning of a word by analogy,

and
- Arthapatti (postulation or Implication): appeals to common sense according to circumstances.

The ancient and medieval Indian books identify six Pramanas, including **Anupalabdhi (non- perception, negative/cognitive proof)** as correct means of accurate knowledge and to truths.

The most widely accepted and discussed pramanas are:

- Pratyakṣa (Perception)
- Anumāṇa (Inference)
- Śabda (word, testimony)
- Upamāṇa (Comparison, Analogy)
- Arthāpatti (Postulation, Presumption, derivation from circumstances)
- Anupalabdi (non-perception, cognitive proof using non-existence)

Different Ancient Schools and Accepted Pramanas

Schools	Accepted Pramanas
Carvaka school	Pratyakṣa (perception)
Vaisheshika school	Pratyakṣa (perception) Anumāṇa (inference)
Sankhya, Yoga, Vishishtadvaita Vedanta, and Dvaita Vedanta schools	Pratyakṣa (Perception) Anumāṇa (Inference) Śabda (word, testimony)
Nyaya school	Pratyakṣa (perception) Anumāṇa (inference) Śabda (word, testimony) Upamāṇa (comparison, analogy)
Prabhakara Mimamsa school	Pratyakṣa (perception)
	Anumāṇa (inference) Śabda (word, testimony) Upamāṇa (comparison, analogy) Arthāpatti (postulation, presumption)

Advaita Vedanta and Bhatta Mimamsa schools	Pratyakṣa (perception) Anumāṇa (inference) Śabda (word, testimony) Upamāṇa (comparison, analogy) Arthāpatti (postulation, presumption) Anupalabdi (non-perception, cognitive proof using non-existence)

The Advaita Vedanta recognizes six pramanas, namely, Pratyaksa(perception), Anumana (inference), Sabda or Agama (verbal testimony), Upamana (comparison), Arthapatti (presumption) and Anupalabdhi or Abhava(nonapprehension).

Pratyakṣa (Perception)

The word 'pratyaksa' consists of two parts viz. "prati" meaning near or before or related to and "aksi" meaning eye. So, it means the process through which immediate knowledge of an object arises or it means the instrument by which the object is conceived.

Perception or pratyaksa is the most important and fundamental source of valid knowledge. It is accepted by all the philosophical schools both vedic and non vedic. It is first and foremost of all the sources of valid knowledge as it is the most powerful, most fundamental and root of all other sources. Perception gives a direct or immediate knowledge of reality of an object and therefore it is the root of all other pramanas. According to the Nyaya, perception is not the only source of our knowledge, but it is the basis of all other sources or means of knowledge. Hence, it has been said that all the other means of knowledge presupposes perception and must be based on knowledge derived from perception.

Perception is the final test of all knowledge. Perceptual verification is thus the final test of all other knowledge and as such, perception is the chief of all the sources of human knowledge.

Types of Pratyaksha

Pratyaksha is broadly divided into two types:

Direct perception (Anubhava): In this type of perception, the knowledge of an object arises when it comes in contact with sense organs; **smell (nose), touch (skin), form (eyes), sound (ears) and taste (tongue).**

Remembered perception (smriti): The knowledge of an objects is based on the memory (smriti). Once we have seen a table, it is memorised and when the table again appear in front of you, you can easily recognised, what is this?

Alternatively, it can be divided into **indiscriminate perception** (nirvikalpa) where perception of the object is made without recognizing distinguishing features; and **discriminate perception (savikalpa)** where distinguishing features are observed.

Traditionally, there are four ways of obtaining pratyaksha. They are:

- Indriya pratyaksha (Sense perception)
- Manas pratyaksha (Mental perception)
- Svadana pratyaksha (Self-consciousness)
- Yoga pratyaksha (Super-normal intuition)

Anumāṇa (inference):

Anumana literally means such knowledge that follows some other knowledge. **Anumāṇa (inference)** is the knowledge of an object due to a previous knowledge of some sign or mark. In Anumana Pramana, we arrive at the knowledge of an object through the medium of two acts of knowledge or propositions.

Inferential knowledge is produced not by direct apprehension but by means of some other knowledge. The "other" is interpreted in different ways as perceptive knowledge of probans. All systems of Indian philosophy agree in holding that anumana is a process of arriving at truth not by direct observation but by means of the knowledge of *vyapti* or a universal relation between two things.

There are definite steps to be followed in all inferential knowledge. The following steps are accepted for logical deduction of knowledge by the teachers of Advaita Vedanta :

I. Perceptual evidence: We see smoke on the hill
II. Invariable concomitance: Wherever there is smoke, there is fire, as seen in kitchen.
III. Conclusion: Therefore the hill has fire

Śabda (word, testimony)

Sabda or verbal testimony is also called **'apta-vakyas'** (statement of a trustworthy person, and *Agama (authentic word*). A verbal statement can be uttered or written, is human's most potent instrument for transmitting knowledge.

A universal way of communication is either an oral or written message, and we learn mostly through words. We continuously get various information, direction, and knowledge through words. Since school days, we use words as a valid and effective means of bringing about awareness of things, ideas, or emotions. Books, magazines, newspapers, letters, conversations, chats, radio, TV, movies, songs, etc., all depend on words.

A verbal statement conveying valid knowledge must have an authentic source and free from defects. Only a competent person possessed of knowledge can impart accurate knowledge. Such knowledge needs no verification unless, of course, there is doubt about its reliability. If all that we know from verbal testimony were to await confirmation, then the bulk of human knowledge would have to be regarded as baseless.

The process of verbal knowledge (Sabda) cannot be clubbed with inference. Sabda does not involve any knowledge of invariable concomitance, as is the case in inference.

A lot of work has been done in regard to the derivation of the meaning of a sentence, especially by the Mimamsakas. Only that combination of words is called a sentence when four factors are taken care.

They are:

- Expectancy (Akanksha),
- Consistency (Yogyata),
- Contiguity (asatti), and
- Knowledge of the purport (tatparya-jnanam)

Upamāṇa (comparison, analogy)

According to the Mimamsakas and Advaitins, Upamana is the process by which the knowledge of B's similarity to C is gained from the perception of C's similarity to B, which has been seen elsewhere.

The methodology of Upamana for getting knowledge is seen as distinct from mere inference, and is thus accepted as a valid mediate method of knowledge.

For example, a person who has seen his cow in a town goes to a forest and sees a wild cow (gavaya). The person sees the similarity "This wild cow is like my cow", and on this basis, he also concludes the opposite to be equally true, that "My cow is like this wild cow". Thus, by upamana he gains the knowledge of his cow's similarity to the wild cow from the perception of the wild cow's similarity to his cow.

Upamana is a distinct means of knowledge, and it can not be clubbed under **Anumāṇa (Inference)**. We cannot have a universal proposition that a thing is similar to whatever is identical to it. Such knowledge can not be gained without the observation of the two same things together.

Arthāpatti (postulation, presumption)

Arthapatti means postulation, supposition, or presumption of a fact. **Arthapatti** is a distinct valid method of mediate knowledge. In fact, **Arthapatti** is a method of assumption of an unknown fact to account for a known fact that is otherwise difficult. **Arthapatti** can either be from what is seen or from what is heard.

One of the classic examples of this method of knowledge is Shyam; a fat person says that he never eats during the day time, then we can easily postulate that he eats in the night. For the simple reason that without this assumption, his fatness and also his getting fatter cannot be explained.

Anupalabdi, Abhava (non-perception, cognitive proof using non-existence)

According to the Advaitins and the Mimasaka school of Kumarila Bhatt, **Anupalabdhi** is considered to be a separate independent Pramana. **Anupalabdhi** literally means non-apprehension. Its non-perception apprehends the non-existence of a thing.

By not seeing a jar in a place, one knows that it is not there. We use this method of knowledge also very often, and this is evident from statements like: 'There is no teacher in the classroom,' There is no sound here.'

It may seem paradoxical that non-apprehension of a thing is a means to the apprehension of its non- existence (Abhava). Both non-perception, as well as perception, serve as a means to get various knowledge. The knower is conscious of both. They lead to positive and negative experiences.

Direct or indirect knowledge can be the basis of the knowledge of the non-existence of a thing. It could either be based on our immediate non-perception of a thing or even based on inference or verbal testimony. In the former Pramanas, the knowledge is immediate, while in the latter case, which is applicable in supersensual objects, the knowledge of Abhava of a thing is mediate.

Structure and Kinds of Anumana, Vyapti, and Hetvabasha

The Sanskrit word **"Anumana"** is the combination of two words, **"Anu"** means 'after' and **"mana"** means measurement. The whole word literally means measuring after something. According to Indian Philosophy, Anumana is a knowledge that is obtained after proof. We know by now that knowledge derived through **"anumana"** is not direct since it makes use

of previous knowledge obtained from other sources of knowledge like perception, testimony, etc., and enables one to explore further knowledge. Not all the major Indian philosophical systems accept all the pramanas.

Structure of Anumana

Although all the major schools accept **Anumana** as a valid source of knowledge, the understanding and the explanation of each school will have certain variations according to their understanding of knowledge. In Indian philosophy, the inference is used for oneself and inference for others. When inference is used for oneself the propositions are not well structured since its primary aim is the acquisition of personal knowledge without error. In contrast, inference for others has to be well structured because it is used to convince the other of the truth. We shall concentrate mainly on the understanding of **Nyaya School** because it is well known for its logic.

They define the inference as "a process of reasoning in which we pass from the apprehension of some mark **(linga)** to that of something else under an invariable relation **(vyapti)** that exists between them."

Vyapti is essential in Indian philosophy for making a valid inference: however, it is good to know that different schools had different names for **vyapti**; For example, Vaisesikas called it **Prasiddhi** and Samkhya called it **pratibandha**.

Nyaya proposes a longer syllogism; it has five propositions. An argument, according to them, has five parts: **Paksa or Pratinjna, hetu, drastanta, upanaya and nigamana**.

Here is a standard example to understand this;

Types	Examples
1. **Paksa** (The Thesis / Pratijna – Proposition)	The hill has fire
2. **Hetu** (Reason or the ground)	Because it has smoke
3. **Drstanta** (the corroboration)	Wherever there is smoke there is fire, as in the kitchen
4. **Upanaya** (The application)	the hill is so
5. **Nigamana** (the conclusion)	Therefore, the hill has fire

In this process, we begin asserting something. We provide the reason / the ground for the assertion and make a universal proposition that shows the concomitant relationship between the two with an example then we apply the universal proposition to the present case and make a conclusion from the preceding propositions. This type of syllogism is said to have **anvaya vyapti** – since it denotes a positive concomitance – if there is smoke then there is fire.

We shall give a specimen from the western example:

> 1) Ram is mortal
> 2) Because he is a man
> 3) All men are mortal like my grandfather
> 4) Ram is also a man
> 5) Therefore, Ram is mortal.

The purpose of giving this example is also to show how Indian philosophy combined both induction and deduction together in the same syllogism. The first three propositions (1 – 3) form inductive syllogism, while the last three (3 – 5) form as a deduction. Proposition no. 3 is the conclusion for the induction and the major premise for the deduction.

When it denotes negative concomitance, it is said to have **vyatireka Vyapti**. An example of this is the opposite of what we have stated above. The hill has no smoke; because there is no fire; wherever there is no fire, there is no smoke as in the lake (because water and fire are opposed substances); there is no fire in the hill; therefore, the hill has no smoke.

Classification of Inference (Anumana)

Inference here is classified based on the nature of **vyapti** between **hetu (smoke)** and **sadhya (fire).** Vyapti denotes a correlation between two facts of which one is pervaded and the other which pervades.

E.g. Smoke is pervaded by fire and fire pervades smoke. Vyapti is established based on its presence of both in all such events (wherever there is smoke there is fire) and the absence of both (wherever there is no fire there is no smoke).

The classification is based on the relationship (causal uniformity or non-causal uniformity) between the reason and what is inferred.

There are three types of inference:

1. **Purvavat inference:** An inference in which we infer the unperceived effect from a perceived cause. E.g., we infer of future rain from the appearance of dark heavy clouds.

2. **Sesavat inference:** An inference in which we infer the unperceived cause from a perceived effect. E.g. we infer of the past rain from a swift muddy current of water in the river.

3. **Samanyatodrasta inference:** An inference in which we infer not based on causal relation but the experience of uniformity. E.g., on seeing the different positions of the moon at long intervals, we infer that it moves although we might not have perceived the motion.

Vyapti

Most of the Indian thinkers, who regard inference to be a means of knowledge, unanimously accept the principle of invariable and the way of its ascertainment. *Kumārila* states, Vyāpti is not a simple assertive judgment but a necessary judgment. **Jaya Tirtha,** in his Nyāya Sudhā, defines "inference" as a flawless reasoning from a mark to a certain conclusion on the basis of an invariable relation that subsists between them. This invariable relation between the reason (Hetu) and the probandum (Sādhya) is the essential determinate of inference that distinguishes it from other forms of cognition, viz, perception, and testimony. Vyapti is an important factor in attaining inferential knowledge. There is a diversity of opinion among the scholars about Vyapti. The nature of an inference cannot be known without the knowledge of the nature of Vyapti or invariable concomitance.

Vyapti is the uniform, unconditioned, or natural relation between reason and predicate. The reason must be known to be invariably concomitant with the predicate in Vyapti. The universal relation of the reason with the predicate is the Logical ground of inference.

No inference (Anumana) is possible unless there is an **invariable concomitance (Vyapti)** between the mark and the character inferred Vyapti between the middle and major terms means generally a relation of Vyapti of co-existence (Sachacarya) between the two, e.g. wherever there is smoke, there is fire. Previous knowledge is the knowledge of the Linga or mark as having a universal relation with the Sadhya or major term and as being present in the Paksa or minor term.

Though there is a difference of opinion among the philosophers of different schools in respect of the definition, functions, and nature of Vyapti (i.e., invariable concomitance), all of them are of the view that inference is not possible without the proper knowledge of it and hence it has been considered as a special cause (karana) of inference by the Logicians.

Types of Vyapti:

There are two kinds of Vyapti;

Anvayavyapti: It is invariable concomitance of the presence of the reason with the presence of the predicate.

Vyatirekavyapti: It is the invariable concomitance of the absence of the predicate with the absence of the reason.

Hetvabhasha

Vedanta states in Indian logic, a fallacy is called hetvabhasa, which means the middle-term appears to be a reason but is not a valid reason. Vatsyayana points out that the fallacy of the Hetu are called hetvabhasa because these Hetus do not possess the characteristics of the Hetus proper, and yet they appear like the hetus because of their similarity to them.

Gangesa provides three general definitions of hetvabhasa. 1) There are hetvabhasa the object of that valid cognition which is opposite of the absence of the instruments of inference 2. Hetvabhasa is that object which if known prevents the knowledge of Linga from leading to an inference 3. Hetvabhasa is that characteristics which prevents known inference.

There are five kinds of Hetvabasha:

(i) **Asiddha (unfounded or unknown reason):** The reason which is not invariably concomitant with the probandum or that it does not exist in the subject, the reason is to be taken as the unknown reason.

This type of reason is of three forms:

(a) **asrayasiddha:** That reason whose subject is unknown, e.g., the sky lotus, is fragrant because it is a lotus, similar to one in the pond. Here, the subject – sky lotus, is a non-existing thing and so unknown.

(b) **svarupasiddha:** That reason whose form is not to exist in the subject. An example of svarupasiddha is "sound is transitory because it is visible like a pot." Here, visibility is the reason, but that is entirely unknown in sound as it is only audible.

(c) **vyapyatvasiddha:** that reason which has its invariable concomitance with the probandum unfounded.

(ii) **Viruddha** (contradictory reason): It is that which has invariable concomitance with the negation of the probandum. e.g. sound is eternal because, it is a product, like ether. The fact of being a product is actually concomitant with non-eternality,

the opposite of the probandum here.

What is produced is always non-eternal and not-etemal. Therefore, the reason "being a product" becomes a contradictory one.

(iii) **Anaikdntika** (inconstant or straying reason): It is of two kinds, the common strayer and the peculiar strayer. That which is present in all the three paksa, sapaksa and vipaksa, is the common strayer; e.g. (in syllogism) sound is eternal because it is cognizable, the reason cognisability exists in all eternal and non-eternal things. That reason which is absent from both sapaksa and vipaksa but exists only in the paksa, becomes the peculiar strayer, as (in syllogism) "earth is eternal because it has smell" the reason smell does not exist in any sapaksa or vipaksa, but exists only in earth (paksa).

(iv) **Prakaranasama** (counterbalanced or opposing reason): It is that which is opposed by another reason which proves the existence of the opposite of the proposed probandum. For e.g., the sound is non-eternal as it is devoid of all qualities of eternal things. This is opposed by "sound is eternal because it is devoid of all qualities of eternal things." This is also called satpratipak§a one having an adversary.

(v) **Kalatyayapadista (stultified or belated reason**): It occurs when the opposite of the proposed probandum is known to exist in the subject by any other more trustworthy means of cognition. It is also called badhita.

For e.g., the syllogism, "fire is not hot, because it is a product like water'. Here, the probandum proposed to be proved by the reason "being a product" is "absent of heat." But it is opposite "presence of heat" in the subject is already ascertained through perception, as heat is experienced through tactile perception.