Chapter 7 Application of Logic

The b tter ya are at lig c,t he mo e lik ly ya are tob the master fi ya r w n life than its victim.

DO YOU KNOW THAT .....

Skills of logic can never be out – dated.

Knowledge of principles of logic is the key to successful life.

Logic has applications in all fields of life.

Logical thinking is wider than scientific thinking.

Computer science is based on principles of logic.

Logic is essentially the study of reasoning or argumentation. We all use reason all the time to draw inferences that are useful to us. Study of logic grooms us to construct good arguments and to spot bad ones. This is a skill that is useful in every field as well as in everyday life. Let us learn application of logic in some important fields like – Law, Science, Computer science and everyday life.

7. 1. APPLICATION OF LOGIC IN EVERYDAY LIFE

To cm prehend is essentially to draw ca clusia s frm an already accepted lig cal system – Alb rt Einstein

Logic is useful in our everyday life in many ways. **In our daily affairs we have to make many decisions and decision making is not possible without logic.** Every day we come across many situations, problems, or challenges that may be trivial or serious. For instance, simple situations where a housewife has to choose a grocery shop to buy quality products, or choose a juicer of a certain company from various available brands in market, or an important and challenging situation before a youngster, of choosing a career or a life partner.

Good or valid reasoning is necessary to take correct decisions in such situations. Irrational decisions, influenced by advertisements, emotions, biased opinions etc. are not useful. For example a student, who has passed S. S. C with good marks, has to decide about his career before taking admission for science, commerce or arts. His decision may get influenced by many factors like – popular trend in society to become say an engineer, parents desire of their child becoming a doctor, pressure from friends, where all friends are taking admission for commerce, relatives saying no for taking arts, and his own wish to become a singer. In such a situation one needs to think logically, by analysing the situation, finding out various options available, deciding the priorities, understanding one's own interests, talents, abilities, and aptitude for a certain field. For this one can even seek vocational guidance. And finally one arrives at a right decision. **Logical thinking thus helps us to take right decisions at right time, which in turn can make us successful in all spheres of life. And success in life gives us confidence in our innate powers to think rationally.**

Logical thinking is analytical or inferential thinking. It has to be developed with proper guidance and training. Logic cultivates the power to understand abstract concepts. With maturity one improves and with practice one can strengthen these powers. This is the reason why all competitive exams like – C. A, Law, UPSC, MPSC etc. have one paper of reasoning to test students reasoning ability.

This does not, however, imply that without

formal training in logic one cannot reason logically. Logical reasoning in fact is an inbuilt feature of human mind. Study of **logic only makes one better or well – equipped to reason correctly than the person who has not studied logic.**

Logic is useful in communication and conveying. One of the important purpose of language is to communicate our thoughts, ideas, opinions, and feelings with other people. Knowledge of logic can make our communication more precise and perfect, by enhancing our ability to express ideas clearly and concisely. To make people understand what we wish to convey. It is necessary that the subject matter is expressed in logical order, there are no inherent inconsistencies and the important points are highlighted with logical justification. This will help us not only to convey our ideas, thoughts or feelings precisely but also to convince people.

Knowledge of principles of logic enables us to evaluate and critically analyse others arguments. It also develops our ability to formulate argument rigorously. In our day to day life many arguments by people from various fields attract our attention like – a salesman persuading us to buy product of a certain company, an advertisement telling us how a particular product is good and should be preferred over other similar products, friends / parents / relatives advising us regarding an important decision in life, a politician convincing us for giving vote for him and his party. Knowledge of rules of logic and fallacies empowers us to evaluate such arguments and decide if they are good or fallacious. Logic also helps us to formulate correct arguments and avoid fallacies when we think, form opinions, reason, debate or argue with others. Thus logic helps us to refute others arguments and prove one's own argument easily.

Logic is also useful in discussions, when the aim is to understand the topic of discussion and arrive at some common agreement. knowledge of fallacies, definitions can help in gaining better insight into the topic and arrive at mutual agreement.

7.2 APPLICATION OF LOGIC IN LAW

Every legal analysis should begin at the point of reason, continue along a path of logic and arrive at a fundamentally fair result." (Sunrise Lumber V. ðh nson, Appeal No. 165)

Knowledge of principle of logic empowers us to reason correctly by training us to differentiate between good and bad reasoning. This is very important and more clearly demonstrated in legal trials, than in any other field.

Evaluating and creating arguments is essential to the crafts of lawyering and judging. It is important for practitioners as well as students of the law to understand the basic principles of logic that are used regularly in legal reasoning and judicial decision making. This understanding includes. (1) Expertise in using inductive reasoning e.g. the methods of analogy and simple enumeration – by which inferences are drawn on the basis of past experience and empirical observation. "The Rule of Law" – that like cases be decided alike – is grounded logically in inductive reasoning. (2) Elementary understanding of deductive logic, especially of argument forms called 'syllogism', gives lawyers, judges, and students of the law a valuable tool for deciding whether an argument in a legal opinion is valid or fallacious.

To criticize, reserve, or overrule an administrative or judicial decision as "arbitrary," "capricious," "unsupported by law "or" contrary to precedent" is to say nothing more, but nothing less, than that the decision is deficient in logic and reason.

The role of logic is significant in all the three important aspects of legal system – making of laws, execution of laws and interpretation of laws.

The language used is very important while making legal laws. The laws should not be vague or ambiguous. They ought to be very clear and precise. The precision of details is also necessary in the drafting of contracts, wills, trusts and other

legal documents. This is possible when the words used in laws are properly defined. Knowledge of principles of logic is important and necessary for making laws and legal documents.

Execution of laws is the essential aspect of legal system. The main function of judicial system is to resolve disputes. It is necessary that the judgement arrived at is definite and fair. The entire process of legal trial is based on application of principles of logic. Knowledge of different types of fallacies is very useful in legal trials. Knowledge of fallacies not only enables lawyers to detect errors in opponent's arguments, but it also helps them to argue correctly and justify one's own stand. Finally by applying principles of logic, argumentation of lawyers is evaluated, evidence before the court is weighed and a fair judgement is arrived.

For resolving disputes, sometimes, a legal system has to apply some law or a rule or a principle to a set of facts so that some judgement is possible. One lawyer for instance, to defend his client may claim that a specific rule applies to the facts whereas the opponent lawyer may claim that the rule does not apply. In such cases knowledge of logic is useful in correct interpretation of the law or rule.

7. 3 APPLICATION OF LOGIC IN SCIENCE

Science is defined as, **'A systematized body of factual knowledge collected by means of scientific method.'** Science is born out of man's inherent curiosity to explore and understand the world around him. Man's thirst for knowledge is to know 'true' nature of facts. Our understanding of facts, however, need not be always correct. So there is a need to have a test to distinguish between correct and incorrect explanations of facts. The explanations which are rational, logical and based on factual evidence are accepted as correct explanations in science.

The scientific method (Hypothetico deductive method) clearly illustrates how scientific thinking follows logical thinking. Every stage in scientific method has its basis in logic.

(1) The first important step in scientific method is – Formulation of hypothesis. Though the role of creative imagination is significant in suggesting a hypothesis, it is not a result of wild, but a logical guess. Deductive and inductive inferences like simple enumeration, analogy may suggest hypothesis to scientist.

(2) The suggested hypothesis should be a good hypothesis. To decide whether it is relevant, self – consistent, compatible with other laws, knowledge of rules and principles of logic is necessary.

(3) In order to verify the hypothesis, what are the relevant facts to be observed and data to be collected, whether the evidence collected is relevant and sufficient, what experiment to be conducted, all these decisions have basis in logical thinking.

(4) Most of the hypothesis are verified indirectly in science by deducing consequences form the hypothesis. Deductive reasoning is necessary for such deductive development of the hypothesis.

Our knowledge of logic further makes it evident that, indirect verification commits the fallacy of affirming the consequent. So the next step is to prove the hypothesis by showing that no other hypothesis can explain the facts except the proposed hypothesis. As one connot possibly know all alternate hypotheses, it is not possible to prove the hypothesis. Thus we logically come to the conclusion that scientific laws and theories cannot be conclusively proved and scientific knowledge is probable.

When any law or a theory is proved in science, only the evidence in its support is not enough, the proof / the argument should be valid. Knowledge of logic helps in deciding validity of argument.

(5) Scientific laws explain facts by introducing different types of orders into facts like – classificatory, causal, mathematical and order introduced by theories. All

these orders are arrangement of facts as per some plan which is based on logical thinking. Theories introduce order among laws which fall within its scope. This is the highest kind of order in science. It is also known as vertical organization in science. From theories laws can be deduced which in turn explain facts. This shows that science as a system is based on principles of logic.

Relation between scientific thinking and logical thinking is one sided. Logic helps science but science cannot be useful in logic. Logical thinking is wider than scientific thinking;rather scientific thinking is based on logical thinking. Technology which is application of scientific laws and theories is also based on logical consequences and predictions which are derived from scientific theories.

7. 4 APPLICATION OF LOGIC IN COMPUTER SCIENCE

Computer is the most significant invention of the 20th century. Computers have influenced our life to great extent. They are used at almost every workplace and home. Computers have becomes almost indispensable in modern man's life. Though computer appears to be superior to man, it cannot think and reason like man. It can only perform as per the instructions given to it. However what makes it a brilliant invention is the fact that it is considerably faster, accurate, and consistent than man. It can do multiple tasks at one time and unlike man it can function continuously for hours.

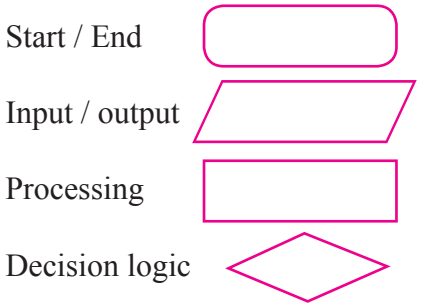
Computers can perform certain tasks and solve problems by carrying out instructions given to it. A sequence of instructions describing how to perform a certain task is called a program. Such a program is in a language which computer can understand. The language which computer understands is called. 'machine language'

Knowledge of principles of logic is necessary for making computer programs. Computer uses binary system for its operation. There are only two digits 0 and 1. One of the reasons for this is human logic tends to be binary – true or false, yes or no statements. Information which is in language is coded in binary digits to feed it to the computer. After processing the output given by computer is also in binary digits, which is displayed on the screen by converting it into language.

A computer thus receives stores, understand and manipulates information composed of only 0 and 1. The manipulation of binary information is done by logic circuits known as logic gates. The important logic operation which are frequently performed in the design of digital system are – AND, OR, NOT, NAND, (NOT – AND), NOR and EXCLUSIVE – OR. These logic gates are the basic building blocks of computer. A logic gate manipulates binary data in a logical way. The knowledge of logic gates is essential to understand the important digital circuits used in computers like – addition, subtraction, multiplication. The input output relationship of the binary variables for each gate can be represented in a tabular form by a truth table which is essentially same as truth tables used in logic.

To solve any problem, programmer provides a method to the computer. It is in form of a procedure which is a series of steps in a logical sequence. This is called an algorithm. Algorithm is expressed in form of flow chart, which is essentially a diagram that defines the procedure. A flow chart shows the order of operations and the relationship between the sections of the programs. Flow charts are independent of a particular computer or computer language.

There are some standard symbols which are usually used in drawing flow chart like –



The flow chart to calculate sum of two numbers, for instance, is as follows –

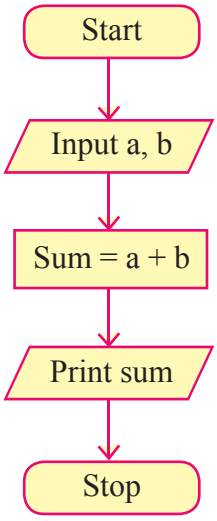
Step 1 : Input two numbers a & b

Step 2 : Calculate sum = a + b

Step 3 : Print sum

Step 4 : Stop

Flow chart –



Summary

- Logic trains us in valid reasoning. This ability to reason correctly is useful in every sphere of life.
- In everyday life, logic empowers us to take correct decisions, which in turn leads to success in life and develops confidence in rational thinking.
- Logic is useful in communication.
- Principles of logic enable us to critically evaluate others as well as one's own arguments.
- Role of logic is important in legal trial. Logic is useful in making of laws, execution of laws and interpretation of laws.
- Scientific, method follows logical thinking. Every stage in scientific thinking has basis in logic.
- Logical thinking is wider than scientific thinking.

Exercises

Q. 1. Fill in the blanks with suitable words in the brackets.

(1) Knowledge of …..…… can make our communication more precise and perfect. *(Psychology / Logic)*

(2) Formal training is …..…… to reason logically. *(Necessary / Not necessary)*

(3) Knowledge of principles of logic enables us to evaluate and critically analyse others …..…… *(Arguments/ Emotions)*

(4) Knowledge of …..…… develops our ability to formulate valid arguments. *(Fallacies / Law)*

(5) Hypothesis is a …..…… guess. *(Wild / Logical)*

(6) Logical thinking is …..…… than scientific thinking. *(Narrower / Wider)*

(7) A sequence of instruction describing how to perform a certain task is called a …..…… *(Program / Process)*

(8) Computer uses …..…… system for its operation. *(Monadic / B inary)*

Q. 2. State whether following statements are true or false.

(1) Logical thinking helps us to take right decision.

(2) Logic gives us confidence in our innate powers to think rationally.

(3) Logic is not an inbuilt feature of human mind.

(4) Logic is not useful in communication and conveying.

(5) Inductive inferences like simple enumeration, analogy may suggest hypothesis to scientist.

(6) Relation between scientific thinking and logical thinking is one sided.

(7) The language which computer understand is called. 'artificial language'

(8) Logic gates are the basic building blocks of computer.

Q. 3. Explain the following.

(1) Application of logic in law.

(2) Application of logic in computer science.

(3) Role of logic in communication.

(4) Importance of logic in everyday life.

Q. 4. Answer the following questions.

(1) Explain with illustration how logic is useful in decision making.

(2) Explain with illustration application of logic in science.

(3) Explain role of logic in making and execution of laws.

(4) Explain how logic helps us to critically evaluate arguments.

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Glossary

Analogy : a form of induction involving inference from known resemblances to further resemblances.

Argument : a group of propositions in which one proposition is accepted on the evidence of the remaining ones.

Argumentum ad baculum : the non-formal fallacy in which there is appeal to force.

Argumentum ad hominem : the non-formal fallacy which involves personal attack.

Argumentum ad ignoratiam : the non-formal fallacy in which a statement is taken to be proved, because its opposite cannot be disproved.

Argumentum ad misericordiam : the non-formal fallacy in which there is appeal to pity.

Argumentum ad populum : the non-formal fallacy in which there is appeal to emotions.

Argumentum ad verecundiam : the non-formal fallacy which involves appeal to improper authority.

Binary connective (operator) : a propositional connective which connects two propositions.

Complement of a class : the class of all objects that do not belong to it,

Compound proposition : a proposition which contains another proposition (or propositions) as a component.

Conclusion : in an argument,the statement which is derived from the premises.

Conjunctive proposition : a compound proposition formed by combining any two propositions with the truth-functional connective "and".

Conjunctive truth function : truth-function which is true only when both the components are true.

Contingency : a truth-functional form which is true under some truth possibilities of its components, and false under other truth possibilities.

Contradiction : a truth-functional propositional form which is false under all truth possibilities of its components.

Contradictory function : another name for negation, its truth-value being the opposite of the truth value of the component proposition.

Converse fallacy of accident : the non-formal fallacy in which we point to a special case to assert a general statement.

Decision procedure : a method for deciding whether an object belongs to a certain class.

Deductive proof : a proof of the validity of an argument in which the conclusion is deducted from the premises by a sequence of (valid) elementary arguments.

Deductive argument : an argument in which the premises claim to provide sufficient evidence for the conclusion.

Direct deductive proof : the deductive proof in which the conclusion is deduced from the premises, by a sequence of (valid) elementary arguments.

Disjunctive proposition : a compound proposition in which the word "or" combines two propositions.

Disjunctive function : the truth function which is false only if both the components are false.

Dyadic connective (Operator) : a propositional connective which connects two propositions.

Equivalence : the propositional connective which is true when both its components have the same truth value.

Equivalent proposition : a compound proposition in which two component propositions materially imply each other.

Fallacy : an error in reasoning in which the argument appears to establish a conclusion, but does not really do so.

Fallacy of Accident : a non-formal fallacy in which what is true in general is considered to be true in a special case,or what is true under

normal circumstances is taken to be true under special (or exceptional) circumstances.

Fallacy of Composition : a non-formal fallacy in which it is argued that a quality which is possessed by a member (or members) is also possessed by the group, or that quality which is possessed by a part (or parts) is also possessed by the whole.

Fallacy of Division : a non-formal fallacy in which it is argued that what is true of a group is true of its members or that what is true of a whole is true of its parts.

Fallacy of ignoratio elenchi : a group of non-formal fallacies in which the argument is irrelevant.

Formal fallacy : a fallacy which arises due to the violation of a rule of logic.

Implicative function : the truth function which is false if and only if the antecedent is true and the consequent is false.

Implicative proposition : a compound propositions which is formed by combining any two propositions with the truth-functional connective "if.. then..."

Inference : the process of reasoning in which the conclusion is drawn from the evidence.

Inductive arguments : an argument in which the premises provide "some" evidence for the conclusion, but the evidence is not sufficient.

Induction per simple enumeration : a generalization in which it is argued that what is true of several instances of a kind is true universally of that kind.

Monadic connective (operator) : a proposition connective which operates on one proposition.

Negation : the propositional connective "~".

Negative proposition : a compound proposition obtained by denying a proposition.

Non-formal fallacy : a fallacy which arises either when words are used ambiguously or when some relevant feature of the argument is ignored.

Premise : in an argument, the proposition from which the conclusion is drawn.

Proposition : a statement which is either true or false

Propositional connective : an expression which connects propositions. The symbols for the five propositional connectives are "~", ".", "v", "⊃" and "≡".

Propositional constant : a symbol which stands for a specific proposition.

Propositional variable : a symbol which stands for any proposition whatsoever.

Scientific induction : the process of establishing a general statement which is supported by both direct and indirect evidence.

Simple proposition : a proposition which does not contain any other proposition as a component.

Sound argument : a valid argument whose conclusion is a true proposition.

Tautology : a truth-functional propositional form which is true under all truth possibilities of its components.

Truth-functional connective (operator) : another name for propositional connective.

Truth-functionally compound proposition : a compound proposition whose truth value is determined by the truth value of its component proposition (or propositions).

Truth-table : a tabular way of expressing the truth values of expressions containing propositional connective.

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