CHAPTER
1

Introduction to Logical Reasoning

LEARNING OBJECTIVES

- Logic as tool for inference
- The strength of logical argument
- Logic and decision making
- Applying logic

Human life is full of situations where one is called to make a decision. This also includes making significant choices about what to believe and what not to. Although everyone prefers to believe what is true, we often disagree with each other about a particular issue due to the subjective nature of our judgements. We often find individuals or groups locked in conflict because our reactions to situations are guided by our impulses. Humankind has developed a mechanism through which we are able to move beyond our individualistic and idiosyncratic notions and establish indisputable facts. This mechanism is called Logical Reasoning and Logic has come to play a very important role in ascertaining what is more credible or whose reasoning is sounder.

It is imperative to understand that Logic is not mainly concerned about finding the 'Truth.' Logic's prime interest lies in finding that, which can be established as a fact using several strands of reasoning supported by sophisticated arguments. It may seem like a big coincidence that the event or situation that is correct will have more substantial proofs or arguments in its favour, rather than the even or situation that is not so

For example, if we are discussing about the direction from which the sun rises, we will always have more proofs or stronger arguments in favour of east rather than west. However, if somehow we get more proofs or stronger reasoning in favour of south, then it is more logical to say that the sun rises from south than to say that it rises from east.

An important application of the logic is in the area of law and the judicial system—an area where proceedings are heavily dependent on logical processes—of any civilized society. The following example tells a lot about the logic and its constituents:

While pronouncing his verdict in one of the most senstational murder cases in India, the judge said, "Though I know that this is the man who committed the crime, I acquit him, giving him the benefit of doubt."

What is the judge saying?

Even though he knows that the defendant is indeed the culprit, the fact has not been proven, that is, it cannot be logically deduced on the basis of arguments and evidence; consequently the accused has to be acquitted.

Despite the above example some authoritativeness can indeed be attached to the way of logical reasoning. No matter how sceptical we are about the points from where we begin to reason, if we follow the rules of logic we will reach an acceptable conclusion. It is almost always possible to distinguish between correct from incorrect reasoning independent of our agreements or disagreements regarding substantive matters. Logic is the discipline that studies the distinction—both by determining the conditions under which the truth of certain beliefs leads naturally to the truth of some other belief, and by drawing attention to the ways in which we may be led to believe something without the respect for its truth. This provides no guarantee that we will always arrive at the truth, because the beliefs or assumptions with which we begin are sometimes erroneous. But following the principles of correct reasoning does ensure that no additional mistake creeps in during the course of our progress.

Hence, Logic can be seen as a tool using which we find out the strength of reasoning or the various arguments put forward in favour of or against something. This is reflected in the origin of the word 'logic'. It takes its roots from the Greek work *logos* which means reason or principle. Taking a broad view, we can see several dimensions, or usages of the term logic. Some of these are given below:

1. A system of reasoning: Aristotle's logic.
2. A mode of reasoning: By that logic, we should sell the company tomorrow.
3. The formal, guiding principles of a discipline, school, or science.

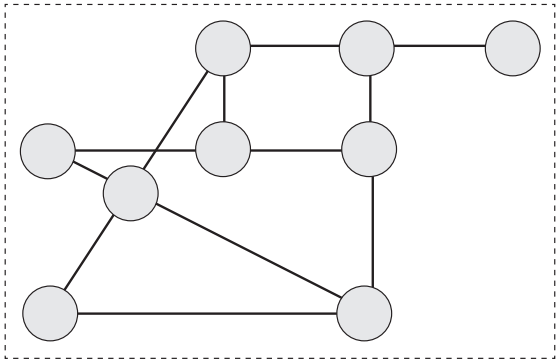
4. The relationship between elements and between an element and the whole in a set of objects, individuals, principles, or events: There's a certain logic to the motion of rush-hour traffic.
5. In the field of Computer Science the term, logic, may mean any of the following:
    a. The non-arithmetic operations performed by a computer, such as sorting, comparing, and matching, that involve yes-no decisions.
    b. Computer circuitry.
    c. Graphic representation of computer circuitry.

Terms related to Logic:

1. Consistency—An attribute of a logical system that is so constituted that none of the propositions deducible from the axioms contradict one another.
2. Completeness—This is an attribute of a logical system that is so constituted that a contradiction arises if any proposition is introduced that cannot be derived from the system.
3. Corollary—An inference that follows directly from the proof of the another proposition.
4. Non sequitur—A conclusion that does not follow from the premises.
5. Subject—The first term of a proposition
6. Predicate—What is predicted about the subject of a proposition.
7. Proof—A formal series of statements given showing that if something is a fact, then something else necessarily follows from it.
8. Paradox—A self contradiction (As in the statement—'I always lie' is a paradox.)
9. Postulate—A declaration of something self evident.
10. Proposition—A statement that affirms or denies something and is either true or false.
11. Negation—A proposition that is true if and only if another proposition is false.
12. Axiom—A proposition that is always true and does not require proofs or disproofs to be true.
13. Tautology—A statement that is always necessarily true (As in the statement—'He is honest or he is not honest.)
14. Contradiction—Opposite of consistency.
15. Logical relation—A relation between propositions.
16. Inductive Reasoning—Proceedings from particular facts to a general conclusion.
17. Deductive reasoning—Proceedings from general facts to a particular conclusion.

Puzzle 1

Put the digits from 1 to 9 into the given circles so that the sum of the numbers in each straight line is the same.



Puzzle 2

Our local town hall has a clock which strikes on the hour and also strikes just once on the half hour. While I was awake the other night, I heard the clock strike once, but I could not tell what time it was. Half an hour later it struck once again, but I still could not tell what time it was. Finally, half an hour later it struck once again and I knew what the time was. What time was it?

Puzzle 3

You are running in a marathon and you overtake the person in second place, what position are you now in?

Puzzle 4

Tree-Tent is a logical game (similar to minesweeper) in which the aim is to identify all tents in the grid. Each tree is exactly connected to only one tent. A tent can be found in a horizontally or vertically adjacent square of a tree. The tents are never placed adjacent to each other, neither vertical, horizontal, nor diagonal. The numbers outside the grid give the total number of tents in the corresponding row or column. A tree might be next to two tents, but is only connected to one, and vice versa. Find all the tents.

								1
	♠			♠				1
	♠	♠						1
								1
							♠	1
					♠			2
1	1	3	1	1	1	1	1	

Puzzle 5

Find the highest total—you can only move up or right—using the mathematical signs coming on the way.

+	4	–	2	+	2
2	+	2	–	2	+
–	1	+	2	–	4
2	–	1	+	1	–
+	1	–	2	+	3
3	+	3	–	4	+

Puzzle 6

In the above question, if we can move up and left only, then what is the maximum sum that we can get?

Puzzle 7

Abhishek said that he was born on 29 February 1900. What birthday will he celebrate in the year 2000?

Puzzle 8

During a recent police investigation, IG Khan was interrogating five criminals—A, B, C, D and E—to try and identify who is the culprit. Below is a summary of their statements:

A: it wasn't E
it was B

B: it wasn't C
it wasn't E

C: it was E
it wasn't A

D: it was C
it was B

E: it was D
it wasn't A

It was well known that each suspect told exactly one lie. Can you determine who the criminal is?

Puzzle 9

At the local school, I was chatting to my sister's friends and noticed a number of things. Jessica has mousey coloured hair and the girl with black hair was wearing a green dress. Lucy is not blonde and Lauren does not have brown hair, Chloe

was wearing a blue dress. The blonde girl was not wearing red and Lauren was not wearing green. I can't remember which girl was wearing a yellow dress. Can you determine the colours of the girl's dresses and their hair?

Puzzle 10

Draw a continuous line that travels in order from 1 to 6. You can only move horizontally and vertically, the line must not cross itself and every square is visited.

			3		
4				1	
	6		5		
2					

Puzzle 11

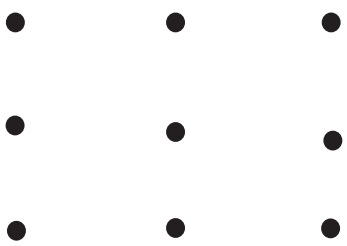
A bank customer had ₹100 in his account. He then made 6 withdrawals, totalling ₹100. He kept a record of these withdrawals, and the balance remaining in the account, as follows:

Withdrawls (₹)	Balance left (₹)
50	50
25	25
10	15
8	7
5	2
2	0
100	99

When he added up the columns as above, he assumed that he must owe ₹1 to the bank. Was he right?

Puzzle 12

Can you draw exactly 4 straight lines that pass through ALL 9 spots, without removing your pen from the paper?



Puzzle 13

In a football syndicate, the winnings amounted to ₹7657. There were more than 30 people in the syndicate but less than 100. Each won exactly the same number of rupees and no paise were involved. How much did each win?

Puzzle 14 to 16

Here is a snippet of curious multiple-choice entrance exam.

14. The answer to question 15 is
(a) B (b) C
(c) A

15. The first question with (B) as the correct answer is
(a) Q3 (b) Q1
(c) Q2

16. The only option not used so far is
(a) A (b) B
(c) C

Puzzle 17

If yesterday was Saturday's tomorrow and tomorrow was Wednesday's yesterday, what day would it be today?

Puzzle 18 to 20

Directions for questions 18 to 20: ***Read the passage given below and solve the questions based on it.***

In a shooting competition, a person is allowed to shoot at four targets successively, followed by the next shooter. When all the shooters have finished one such round, the process is repeated. If a target is hit, the shooter gets 2 points and if he misses the target, the other shooters are awarded one point each. The first shooter to get 60 points wins the shooting competition. In a contest among three persons—Akhil, Bharat and Chand, their score at the end is as follows:

Akhil = 60, Bharat = 53 and Chand = 43.

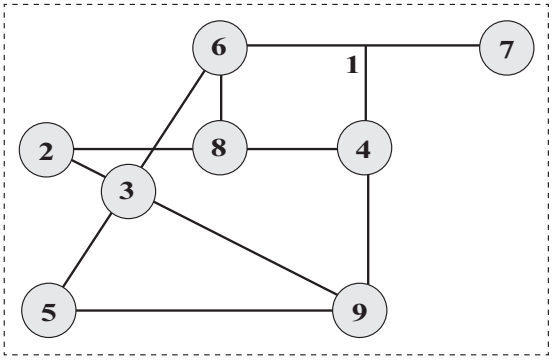
Out of a total of 78 shots being fired, only 43 hit the target.

18. Who was the first to shoot?
(a) Akhil
(b) Bharat
(c) Chand
(d) Cannot be determined

19. Who was the second to shoot?
(a) Akhil
(b) Bharat
(c) Chand
(d) Cannot be determined

20. Who was the third to shoot?
(a) Akhil
(b) Bharat
(c) Chand
(d) Cannot be determined

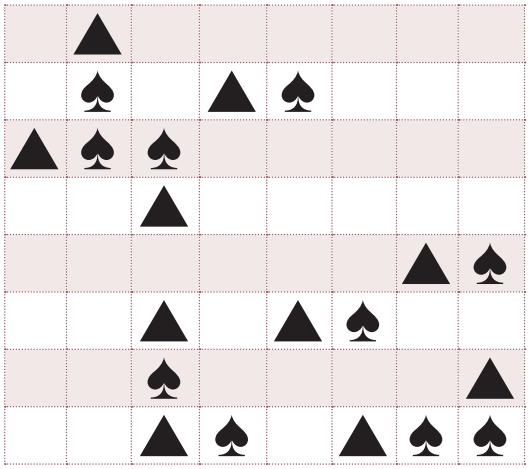
1.



2. 1.30 in the morning. The initial single strike was at 12.30.

3. If you think that you are now in first place, then think again! If you overtake the person in second place, you are now in second place yourself.

4.



5. 8

+	4	–	2	+	2
2	+	2	–	2	+
–	1	+	2	–	4
2	–	1	+	1	–
+	1	–	2	+	3
3	+	3	–	4	+

6. 14

+	4	–	2	+	2
2	+	2	–	2	+
–	1	+	2	–	4
2	–	1	+	1	–
+	1	–	2	+	3
3	+	3	–	4	+

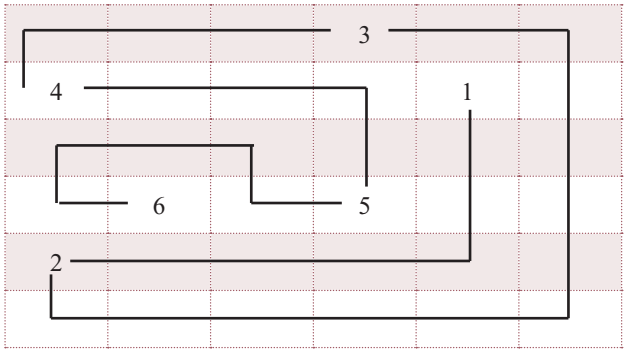
7. Abhishek was lying, 1900 was not a leap year.

8. C committed the terrible crime. The way to solve this puzzle is to look at each clue. We know that exactly one of each person's statements is true. Looking at A statements, let's check to see 'it was B is true? If 'it was B is true, then we know the other statement is false, hence it was E. This is a contradiction. Hence, we now know it wasn't B, nor E (as 'it wasn't E must be the true statement). Looking at C statement, we can similarly determine that it wasn't A either. E statement gives us that it wasn't D, which leaves only C as the culprit.

9.

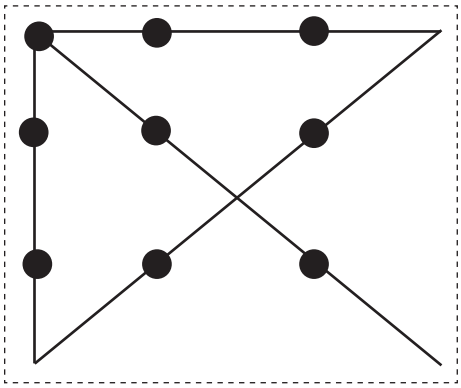
Name	Dress colour	Hair colour
Jessica	Red	Mousey
Lauren	Yellow	Blonde
Lucy	Green	Black
Chloe	Blue	Brown

10.



11. There is no reason what ever why the customer's original deposit of ₹100 should equal the total of the balances left after each withdrawal. The total of withdrawals in the left-hand column must always equal ₹100, but it is purely a coincidence that the total of the right-hand column is close to ₹100.

12.



13. 31 Each one won ₹247.

Solutions to Q.14 to 16:

14. (c)

15. (a)

16. (b)

17. Monday

Solutions to Q.18 to 20:

Each round = 12 shots

Hence, for 78 shots to be fired,

First shooter fired 28 shots (4 × 6 + 4 = 28).

Second shooter fired 26 shots (ended the competition).

Third shooter fired 24 shots.

As per given conditions, for A to score 60 points, he must fire more than 12 shots at the target (since he can get maximum out of 35 from others' misses and he needs to score balance 25 from hitting the target).

Let A hit 15 targets, then A's score = 15 × 2 = 30

+30 (from others' misses).

Hence, A misses 9 shots only.

So A's total shots = 15 + 5 = 20 (not possible).

Let A hit 17 targets, then A's score = 17 × 2 = 34 + 26 (from others' misses).

Hence, A misses 9 shots only.

So, A's total shots = 17 + 9 = 26, i.e., A was the second shooter.

Similarly, for B's point to be 53, he must fire more than 9 shots at target (since he can get a maximum of 35 from others' misses).

Let B hit 12 targets, then B's score = 12 × 2 = 24 + 9 (from others' misses).

Hence, B misses 6 shots only.

So, B's total shots = 12 + 6 = 18 (not possible).

Let B hit 14 targets, then B's score = 14 × 2 = 28 + 25 (from others' misses)

Hence, B misses 10 shots only.

So, B's total shots = 14 + 10 = 24,

i.e., B was the third shooter.

	1st SHOOTER	2nd SHOOTER	3rd SHOOTER
	C	A	B
Targets Hit	12	17	14
Misses	16	9	10
Total Shots	28	26	24
Total Points	43	60	53

18. (c)

19. (a)

20. (b)